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GEOLOGY

OF THE

LEIDY GAS FIELD AND ADJACENT AREAS

CLINTON COUNTY PENNSYLVANIA

By
JOHN R. EBRIGHT and ALBERT I. INGHAM

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DEPARTMENT OF INTERNAL AFFAIRS
William S. Livengood, Jr., *Secretary*

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CONTENTS

Page

GEOLOGY OF THE LEIDY GAS FIELD AND ADJACENT AREAS 1
- Introduction 1
- Location and Topography 1
- History and Development 2
  - Upper Devonian Production 2
  - Lower Devonian (Oriskany) Production 3
- Geologic Investigations 3
- Method of Investigation 4
- Explanation of Map 6
- Stratigraphy 7
  - General Statement 7
  - Surface 8
    - Pennsylvanian System 8
    - Mississippian System 8
      - Mauch Chunk Series 8
      - Pocono Group 8
    - Upper Devonian Series 11
      - Oswayo Formation 11
      - Catskill Red Beds 11
      - Chemung Facies 12
- Structure 13
  - Surface 13
  - Subsurface 16
- Description of Leidy Oriskany Sand Gas Field 18
- Acknowledgments 20

REFERENCES 21

APPENDIX 23
- Well Records 24
- Measured Sections 26
  - Kettle Creek Section 26
  - Mill Run Section 29
  - Oxbow Bend Section 31
  - Summerson Run Section 32
  - Hyner View Section 33

ILLUSTRATIONS

FIGURES

Page

FIGURE 1. Index map showing Leidy area vi

2. Geologic cross section across the Wellsboro anticline at the Leidy gas field 13

PLATES

PLATE 1. Geologic map of Leidy gas field and adjacent areas showing surface structure contours on the base of a Pocono conglomerate ..... pocket

2. Geologic map of Leidy gas field and adjacent areas showing subsurface structure contours on the top of the Oriskany sandstone ..... pocket

3. Composite columnar section of Mississippian and Upper Devonian strata in the Leidy area 8

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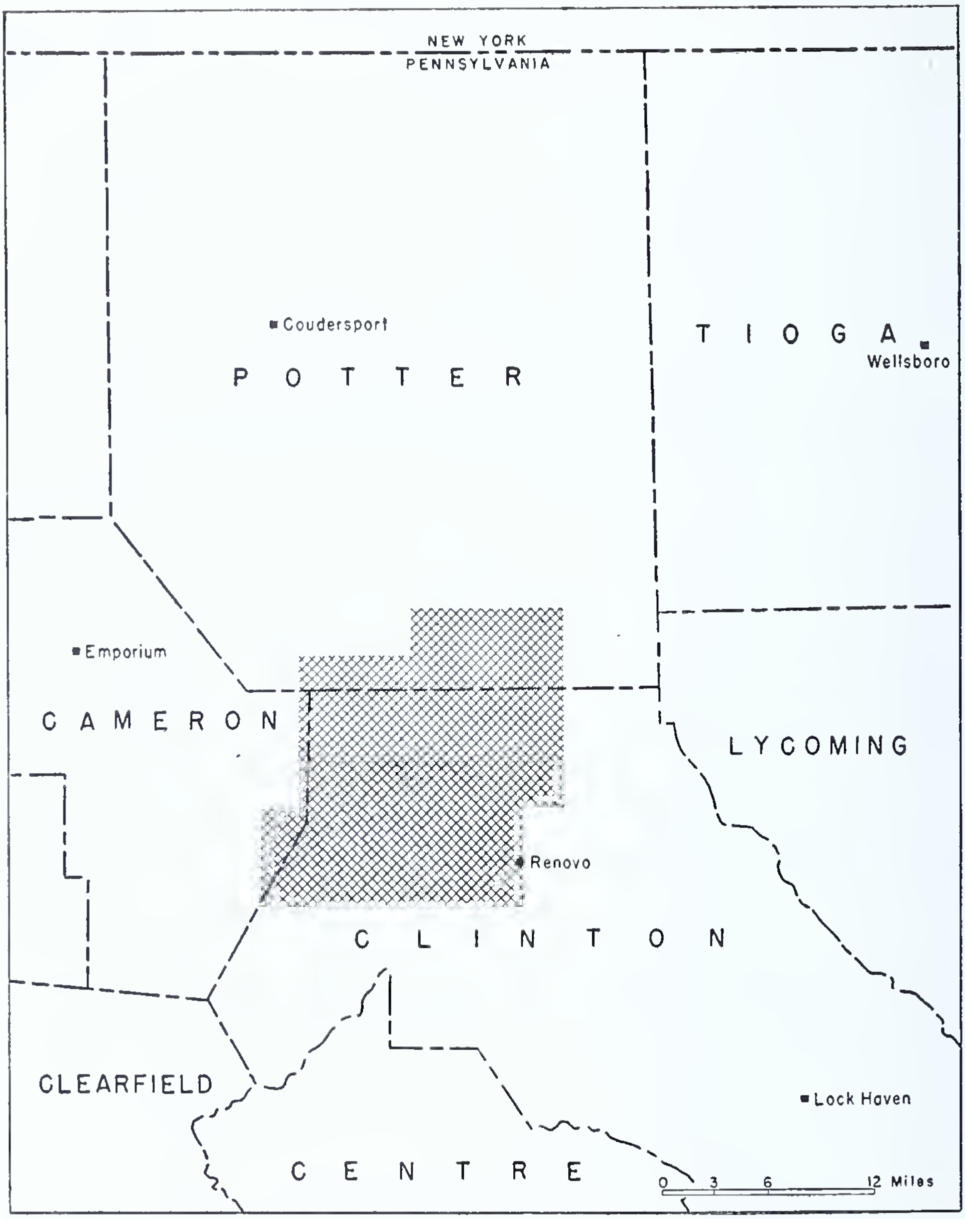

FIGURE 1. Index map showing Leidy area. Pattern delineates area of geologic map.

GEOLOGY OF THE LEIDY GAS FIELD AND ADJACENT AREAS CLINTON COUNTY, PENNSYLVANIA

BY

John R. Ebright[1] and Albert I. Ingham[1]

INTRODUCTION

The major natural gas discovery in Pennsylvania in the last few years was the Leidy gas field, Clinton County, Pennsylvania (fig. 1). The discovery well of the field, Leidy Prospecting Company, Dorcie Calhoun No. 1, was completed on January 8, 1950, obtaining gas production from the Oriskany sand. The well is located on the Leidy dome, a local structural high on the Wellsboro anticline.

The Leidy discovery is the most recent and, as discussed below, one of the most significant Oriskany discoveries in the northern part of the Appalachian plateau province. The initial discovery of gas from the Oriskany sand in the northern part of the Appalachian province was made in 1930 when the Wayne-Dundee and Tioga fields of southern New York and northern Pennsylvania were opened. Numerous Oriskany fields have been discovered since then, most of which are located on anticlinal trends. Prior to the recent Leidy discovery, five of these structural trends were productive, namely the Smethport, Hebron, Harrison, Sabinsville, and Marshlands anticlines. The East Fork-Wharton field (Ebright et al., 1949), located on the Marshlands anticline, was discovered in 1933, but encouraging production was not obtained until 1947. The development of the East Fork-Wharton field was received with much interest as it extended considerably the Oriskany producing province and stimulated the exploration and leasing of other areas to the east, including that of the Wellsboro anticline on which the Leidy field is located. The significance of the recent discovery lies in its geologic location—it has not only opened a new trend in which further discoveries may be made, but it has also focused the attention of the operator and geologist on numerous other undrilled structures in northern Pennsylvania. Several wildcat tests are now drilling or located east and southeast of the Wellsboro anticline in Clinton, Lycoming, and Sullivan counties, and two others are drilling to the southwest in Cameron County.

LOCATION AND TOPOGRAPHY

The Leidy gas field is located in and adjacent to Kettle Creek valley in Leidy Township, Clinton County, in a sparsely settled area 9 miles northwest of Renovo. There is a small amount of agriculture in Kettle Creek valley and some lumbering is carried on in the vicinity. It is a favorite area for hunting and fishing.

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[1] Geologists, Pennsylvania Topographic and Geologic Survey.

The area, located in the Allegheny Plateau physiographic province, is characterized by some of the most rugged topography in Pennsylvania. The maximum relief from the mountain tops to the West Branch of the Susquehanna River is about 1650 feet. The principal streams are deeply incised and are fed by youthful tributaries of steep gradient. Typical of the area are the deeply dissected flat-topped hills, which are capped by erosion-resistant strata, particularly the Pocono sandstones. Dip-slopes formed by these resistant layers are conspicuous on both the northwest and southwest flanks of the Wellsboro anticline in this locality. In the trough of the Clearfield-McIntyre syncline, to the southeast, remnants of massive Pennsylvanian Pottsville sandstones cap the hill-tops giving rise to a "knobby" sort of topography.

Kettle Creek valley illustrates an interesting physiographic phenomenon. Below Honey Run the valley of Kettle Creek is constricted and steep-walled—a typical youthful valley. Upstream from this point the valley widens somewhat and Kettle Creek meanders through the farmland of the valley bottom in the manner of a more mature stream. This is in contrast to what would be expected in a normal stream—narrow valleys and steeper walls upstream becoming wider and more gentle downstream. It appears that the massive, resistant sandstones near the top of the Pocono have arrested the down cutting of the stream and created a temporary base level where these sandstones cut below drainage on the south flank of the Wellsboro anticline, along Kettle Creek, below Honey Run. A slightly meandering stream and a small flood plain were developed upstream in the softer strata below the Pocono, while downstream, where erosion of the sandstones was slower, the stream and valley are in a more youthful stage.

HISTORY AND DEVELOPMENT

UPPER DEVONIAN PRODUCTION

Prior to the discovery of Oriskany gas at Leidy, a shallow (Upper Devonian) gas field had been developed along Kettle Creek. The first producing well was drilled in this area in 1864 and obtained enough gas for domestic purposes. A second well, drilled in 1878 to a depth of 1800 feet, found sufficient gas to fire one boiler. Two other shallow tests were drilled, one in the late 1800's, and the other in 1911-12, both of which had shows of gas. Most of the development in this shallow field, however, occurred in 1922 and 1923 (Johnson, 1923). At the time of Johnson's report, a total of 17 wells had been drilled in the field, seven of which were producing gas; four of these had a total output of 4,000,000 cubic feet of gas per day. Reservoir pressures ranged from 125 to 700 pounds. None of the wells in the shallow field are now commercially productive.

A number of the recently-drilled Oriskany tests have encountered considerable quantities of gas (up to 500,000 cubic feet per day) from several lenticular sands of the Chemung (Upper Devonian) section (see well records in the Appendix). It is possible that drilling with these shallow sands as an objective might be economically feasible in view of the shallow drilling depths and the nearness of pipe line outlets.

LOWER DEVONIAN (ORISKANY) PRODUCTION

Following the shallow sand developments described above, there is no record of further testing until April 1949 when the Leidy Prospecting Company located their Dorcie Calhoun No. 1, approximately 1000 feet northeast of the village of Leidy. There are reports that the location of the well was made "on a hunch." It was spotted, however, near the axis of the Wellsboro anticline as determined some years ago by Johnson (1923) and Cathcart (1934). The Calhoun test, discovery well of the Leidy Oriskany gas field, came in on January 8, 1950. The well was out of control during the early stages, but its production was estimated at 15,000,000 cubic feet of gas per day, with a reservoir pressure of 4200 pounds; production was obtained at a depth of 5660 feet in the upper one foot of the Oriskany sand. The productivity of the first well, in addition to its geologic location, stimulated intense interest in the area and consequently development has been fairly rapid. By the middle of February 1951, 17 producing wells and 3 dry holes had been completed. In addition to these, 44 other tests were drilling or located on the dome and the adjacent synclines on this date. The producing area of the field is now approximately 3½ miles long and 2½ miles wide; the ultimate limits of the field have not been determined.

GEOLOGIC INVESTIGATIONS

Ashburner and Sheafer (1885), members of Pennsylvania's Second Geological Survey, made a geologic reconnaissance of Clinton County but failed to recognize the existence of the Wellsboro anticline. No further geologic work by the Survey was done until 1923 when Johnson (1923) made a brief report on the shallow Upper Devonian gas field heretofore described. He recognized the presence of a local structure in Leidy Township which he called the "Kettle Creek" anticline.

Following discovery of gas in the Oriskany sand in 1930, S. H. Cathcart (1934) made a reconnaissance structural investigation of the Allegheny Plateau between McKean County on the west and Delaware River on the east. The structure of this area was determined by the strike and dip method; special efforts were made to define the elongated domal structures on the anticlines. Cathcart's study showed the structural grain of the region, and in various areas it was a refinement and/or addition to the geologic structure as delineated by Pennsylvania's Second Geological Survey of the latter part of the 1800's. Cathcart further showed that the Kettle Creek anticline of Johnson was part of the Wellsboro anticline, and he determined the presence of a local structural high, the Leidy dome, on which the Leidy field is located.

The East Fork-Wharton gas field area located on the Marshlands anticline, the next upfold to the northwest of the Wellsboro anticline, was studied geologically in 1948 and the results of this investigation have been published (Ebright et al., 1949). A similar project was begun in the Leidy gas field area in the summer of 1950. A preliminary map and text (Ebright et al., 1950, PR 134) are in press at this writing. The final maps included herewith, and this text are a more extensive and detailed description of the geology.

Attention is called also to the current investigation of the high-alumina clays principally in Clinton and Clearfield counties, by John H. Weitz and Robert C. Bolger, Cooperating Geologists with the Pennsylvania Topographic and Geologic Survey. This work is focused on the Mercer clay of Pennsylvanian age which is found chiefly in the synclines. It will contribute greatly to the knowledge of the areal geology of the region and will complement the mapping of adjacent anticlinal areas for oil and gas prospecting.

METHOD OF INVESTIGATION

The field work in connection with this study was done by J. R. Ebright assisted by Harry V. Gouse. The project was under the direction of A. I. Ingham. The report was written by Ebright and Ingham.

The geology of the Wellsboro anticline in the area embraced by this study was determined by strike and dip measurements, areal distribution of various stratigraphic units, and the tracing of key beds. Elevations were determined by the altimeter and hand level methods. Stereoscopic studies of aerial photographs proved extremely useful in augmenting the field work.

As in the East Fork-Wharton study, (Ebright et al., 1949), strike and dip data have been evaluated according to reliability and designated on the maps as *first, second,* or *third* class. Criteria used in classifying these measurements include the size of outcrop, regularity of bedding within a single outcrop, concordance of measurements in local areas, and character of sedimentation. A relatively large exposure of uniformly-bedded strata may merit a first-class rating, whereas one in which cross-bedding is suspected would be given a third-class rating. If there is little doubt that the strata are cross-bedded, a measurement either has not been taken, or a field note has been made to record the geologist's on-the-spot opinion of the reliability of the outcrop. Outcrops in the area are not plentiful and may consist of no more than a few square feet of strata exposed in a stream bed or gully. Hence the geologist must frequently make measurements on most outcrops and later attempt to judge questionable data in light of the composite picture. The authors have found the classification of strike-dip readings extremely helpful in evaluating the relative weight to be placed on measurements, particularly in areas of anomalous structure. The classification will also enable the reader to judge the evidence on which the structural interpretation is based.

METHOD OF INVESTIGATION

In delineating the geologic structure, elevations were determined on two key horizons—(1) the top of the Catskill red beds, and (2) the base of a Pocono conglomerate. The outcrop of the former is shown on Plates 1 and 2 (in pocket) by a dotted line; the outcrop of the latter by a dashed line. Structure contours on the base of the Pocono conglomerate are also shown on Plate 1.

In the field, the top of the Catskill red beds has been placed at the top of the more or less continuous red Upper Devonian section. The overlying Oswayo (uppermost Upper Devonian), Pocono, and Mauch Chunk contain some red units, but these post-Catskill sediments are predominantly shades of gray. The contact between the Catskill and Oswayo is fairly sharp, but, because this section may be covered, close observance of soil colors and float is necessary to determine the contact between the red Catskill and the dominantly brownish-gray and gray Oswayo.

The base of the Pocono conglomerate, contour horizon of the map, Plate 1, can usually be found with little difficulty. Lithologically this key unit is distinctively coarse pebbly to conglomeratic and often forms a prominent escarpment with accompanying small to tremendous boulders, some as much as 20 feet high; the boulders may be massed to form a "rock city." In some instances only conglomerate float is found and in these cases it has been assumed, in computing structural data, that the elevation of the highest such float found minus 30 feet is the base of the conglomerate (the unit is believed to have an average thickness of 30 feet). The conglomerate frequently stands out in sharp relief on aerial photos. Stereoscopic study of these photos, together with some ground control and the excellent topographic maps available in the area have enabled the authors to pick the datum.

The previously-mentioned high-alumina clay project being carried on by Weitz and Bolger in this region has proved the advantages in accuracy and economy of utilizing aerial photographs to implement geologic field work. An aerial photograph of a portion of the Clinton County clay-producing area was used to illustrate the value of photogeologic methods in mineral investigations (Stephenson and Foose, 1948, fig. 1). The use of air photos in the present study has further indicated the great advantage to be gained by the application of photogeologic techniques in rough, heavily-wooded areas.

In this investigation, the aerial photographs used were contact prints of photographs taken by the U. S. Geological Survey for the preparation of topographic maps.[2] The folding pocket-style refraction type and the mirror-type stereoscopes were employed in studying the aerial photographs.

The massive, resistant, cliff-forming sandstone units stand out in relief on the photographs and can be followed with comparative ease. The Pocono conglomeratic sandstone key bed and several underlying sandstone members are particularly prominent and can be traced with little difficulty in most areas. Where slopes are steep the cliffs tend to merge, so that care must be exercised in tracing horizons to avoid jumping from one unit to another.

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[2] For complete information concerning available aerial photograph coverage of areas in Pennsylvania contact the State Planning Board, Department of Commerce, Harrisburg, Pa.

Correlation of the data obtained from study of the aerial photographs with points on the excellent topographic maps available for this area afforded the authors an unusual advantage in determining elevations and working out structural relations.

Examination of the photo-index mosaics was helpful in visualizing certain of the broader geologic relations of the area. The mosaics covering the Wellsboro anticline and the Hyner anticline (the next upfold to the east of the Wellsboro structure) rather clearly reveal the nature of the surface strata. The "knobby" topography of the Pottsville and Allegheny is evident in the Clearfield-McIntyre synclinal area. The even Pocono dip slopes are readily discernible on the flanks of the Wellsboro and Hyner anticlines, and toward the axial part of both structures the softer, more gently-modelled topography of the Devonian is revealed.

EXPLANATION OF MAP

The base for the accompanying maps, Plates 1 and 2, was compiled using the 7½ minute quadrangle topographic maps issued by the U. S. Geological Survey. Both maps show the same basic data, the only difference in the two being in the contour horizon: Plate 1 is contoured on the base of a Pocono conglomerate and shows the surface structure; Plate 2, contoured on the top of the Oriskany sandstone, shows the subsurface structure.

The following explanation applies to common data shown on both maps: All surface elevations refer to the base of the Pocono conglomerate. The symbol, **X2100**, shows the elevation of the base of the conglomerate above sea level as determined in the field; those elevations designated with the suffix letter **A**, such as **1800A**, were determined from aerial photo-topographic map studies. In the areas where the Pocono conglomerate has been removed by erosion, the elevation has been estimated from the top of the Catskill red beds, for example, $\mathbf{X}\frac{\mathbf{2240E}}{\mathbf{1590C}}$. The top number, **2240E**, is the elevation of the base of the conglomerate estimated from the top of the red beds. Where the suffix **P** is used with the number below the line, it indicates an elevation on the base of the Pottsville. In this case the upper number is the elevation of the base of the Pocono conglomerate estimated from the base of the Pottsville.

The outcrop of the two key horizons is also indicated on the maps, the dotted symbol referring to the top of the Catskill red beds, the dashed symbol to the base of the Pocono conglomerate. The classification of strikes and dips is discussed on page 4.

The map designation of the Oriskany sand wells is denoted by the initials of the property owner and the number of the well on the tract. For example, **DC-1** is the index number for the No. 1 well on the Dorcie Calhoun tract. For wells on land owned by the Commonwealth of Pennsylvania, the designation is, for example, **PA-1-2**; here the first number is the well number and the second is the tract or warrant, whichever the case may be. Elevations below sea level on the top of the Oriskany sand are shown with each completed well symbol.

Locations of the shallow sand (Upper Devonian) gas wells are taken from the Johnson (1923) report, and the numbers correspond with those used in that publication.

A small portion of the East Fork-Wharton gas field is shown in the northwestern part of the maps, Plates 1 and 2. The Oriskany trace of the axis of the Marshlands anticline, on which the Wharton dome is located, was determined from subsurface data made available since publication of the East Fork-Wharton report (Ebright et al., 1949).

STRATIGRAPHY

GENERAL STATEMENT

The surface strata in the area and those penetrated in drilling are as follows:

AGE	EXPOSED ROCKS		SUBSURFACE ROCKS	
Pennsylvanian	*Allegheny*			
	Pottsville	*Homewood* *Mercer* *Conoquenessing*	*Pottsville*	*Homewood* *Mercer* *Conoquenessing*
Mississippian	*Mauch Chunk*		*Mauch Chunk*	
	Pocono	*Burgoon* *Patton**	*Pocono*	*Burgoon* *Patton**
Devonian				
Upper	*Oswayo* *Catskill facies* *Chemung facies*		*Oswayo* *Catskill facies* *Chemung facies* *Portage facies*	
Middle			*Tully** *Hamilton* *Onondaga*	
Lower			*Oriskany* *Helderberg*	

Studies of the subsurface section in the Leidy area have not yet been made. These will be published later in connection with the Survey's program of stratigraphic studies of deep test wells in various parts of Pennsylvania. The Oriskany sand from the Godfrey Cabot, C. Foley No. 1 test (CF-1) has been examined, and a summary description is given on page 18.

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* Prominent members.

SURFACE

The strata exposed at the surface in this area include, in descending order: the Allegheny group and the Pottsville series of the Pennsylvanian system; the Mauch Chunk series and the Pocono group of the Mississippian system; and the Oswayo formation, Catskill red beds and the Chemung facies of the Upper Devonian series.

Four stratigraphic sections of the rocks exposed in this area were measured in detail. The locations and descriptions of these sections, together with suggested correlations, are given on pages 25 to 31 of the Appendix. A fifth section, located near the village of Hyner, is included because of its completeness and its proximity to the Leidy area. A composite columnar section of the surface strata is given on Plate 3.

Pennsylvanian System

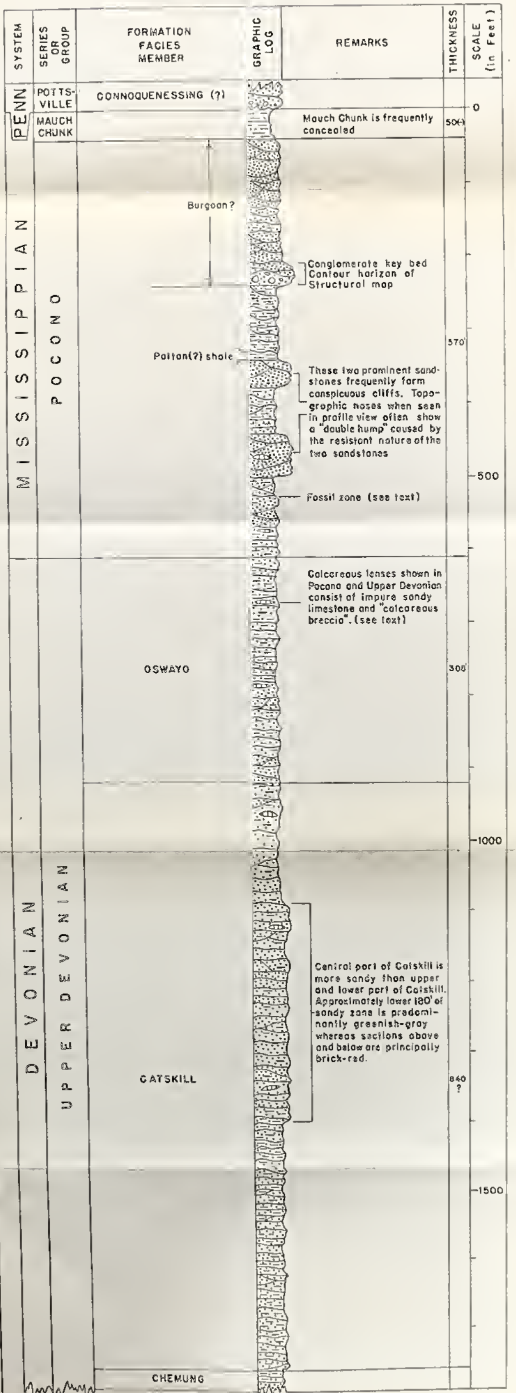
Strata of the Pennsylvanian system remain only on the southeast flank of the Wellsboro anticline and in the deeper parts of the Clearfield-McIntyre syncline. Elsewhere in this area they have been removed by erosion. These strata were not studied in detail, but reconnaissance investigations indicate the Allegheny group contains sandstones, shales, clays, and several coal beds of commercial value. In descending order, the units of the Pottsville series are tentatively identified as the Homewood sandstone, the Mercer member, which contains the Mercer clay and coal, and the Conoquenessing sandstone. Both the Homewood and Conoquenessing sandstones are frequently conglomeratic.

Mississippian System

Mauch Chunk Series. The author's identification of Mauch Chunk is based on the presence of red beds between the Upper Pocono (Burgoon?) and the Pottsville. The interval occupied by the Mauch Chunk is rarely exposed in the area, but occasionally a thin bed of red shale or shaly siltstone is found near the top of the section. The Mauch Chunk "reds", however, appear to be in the minority in the formation, as much of the section is brownish-gray or grayish-green, similar to Pocono units. The Mauch Chunk, like the Pottsville series, is present only on the southeast flank of the anticline and in the adjacent synclinal basin.

Pocono Group. The upper 200 feet of the Pocono group (pl. 3) is a fairly continuous, medium- to very coarse-grained white to brown sandstone, which occupies the same stratigraphic position as, and may be correlative with, the Burgoon sandstone of southwestern Pennsylvania. The lower 30± feet of this sandstone is frequently conglomeratic and contains angular to subrounded milky quartz pebbles. Flattened pebbles, typical of some of the Pocono conglomerates in western Pennsylvania, were not found in the Leidy area. Occasionally, pebbles up to 1½ inch in diameter have been found but the greatest number are under ½ inch. Hematitic bands or streaks are common near the base of this sandstone section. The conglomeratic unit is an excellent key bed and its base is the contour datum of the accompanying map (pl. 1). The writers believe that in the

COMPOSITE SECTION
OF
MISSISSIPPIAN AND UPPER DEVONIAN
LEIDY GAS FIELD AREA
CLINTON COUNTY, PENNSYLVANIA


SYSTEM
SERIES OR GROUP
FORMATION FACIES MEMBER
GRAPHIC LOG
REMARKS
THICKNESS
SCALE (in Feet)
PENN
POTTS-VILLE
CONNOQUENESSING (?)
MAUCH CHUNK
Mauch Chunk is frequently concealed
50(+)
0
MISSISSIPPIAN
POCONO
Burgoon?
Conglomerate key bed Contour horizon of Structural map
570'
Patton(?) shale
These two prominent sandstones frequently form conspicuous cliffs. Topographic noses when seen in profile view often show a "double hump" caused by the resistant nature of the two sandstones
500
Fossil zone (see text)
Calcareous lenses shown in Pocono and Upper Devonian consist of impure sandy limestone and "calcareous breccia". (see text)
OSWAYO
300'
1000
DEVONIAN
UPPER DEVONIAN
Central part of Catskill is more sandy than upper and lower part of Catskill. Approximately lower 180' of sandy zone is predominantly greenish-gray whereas sections above and below are principally brick-red.
CATSKILL
840 ?
1500
CHEMUNG

East Fork-Wharton area (Ebright, et al., 1949, pp. 6, 38) this conglomeratic sandstone was erroneously correlated as the basal unit of the Pottsville series; more recent and conclusive evidence indicates it is Mississippian in age and correlative with the Pocono conglomerate of the Leidy area. This is supported by correlations of the Leidy and East Fork-Wharton measured surface sections and by the finding of red beds (Mauch Chunk) above the 200-foot sandstone section and below the Pottsville in or near the Clearfield-McIntyre syncline of the Leidy and adjacent areas.

Chance (1880, pp. 131-134), in his Hyner section placed the base of Pottsville (No. XII) at the base of a 35-foot coarse-grained sandstone which is believed to be correlative with the Pocono conglomerate discussed above. Ashburner, in the same report (pp. 74-76), placed the base of Pottsville higher in the section at the base of a 25-foot conglomerate; this conglomerate is just above a red shale which the present authors believe is Mauch Chunk. Therefore, it appears that Ashburner probably correctly identified the Pottsville while Chance confused the Patton (?) red shale with Mauch Chunk red beds and incorrectly drew the base of Pottsville approximately 186 feet too low stratigraphically. The error is repeated in the Clinton County map (Chance, 1880, pl. 1) where much of the Second Survey's unit XII (Pottsville) in the vicinity of Kettle Creek, northwestern Clinton County, is actually Pocono.

Another prominent member of the Pocono is a thin band of red shale or siltstone encountered below the base of the above mentioned conglomerate. This red bed, observed at 141 feet in the Kettle Creek measured section, 145 feet below the top of the Summerson Run section, at 310.2 feet in the Mill Run section, and in the East Fork-Wharton area (Ebright et al., 1949), may be the stratigraphic equivalent of the Patton shale. The name Patton was applied to a bed of red shale which crops out on Redbank Creek near the west line of Jefferson County, Pennsylvania (Campbell, 1904, pp. 5-6). In the sections measured in the Leidy area, the thickness of this red bed is approximately 3 feet, but in the Hyner View section, red is present in nearly the entire interval between 90 and 231.1 feet. Part or all of this may represent thickened Patton, but it appears more likely that the Pocono in this section is becoming more red eastward.

Below the Patton are two fine- to medium-grained, brownish-gray or grayish-brown, thin- to medium-bedded, frequently cross-bedded sandstones which form rather prominent cliffs or a "double hump" in the topography (pl. 3). On the flat terrace between these two sandstones, a thin bed of red shale or siltstone was found in a few locations other than in the measured sections. Within the lower sandstone a thin zone of pebbles was observed at 458.1 feet in the Mill Run section and at 336.9 feet in the Hyner View section. These conglomerate units may be equivalent to the Griswold (Griswolds) Gap conglomerate of northeastern Pennsylvania assigned to the lower part of the Pocono by White (1881, pp. 56, 57). They also may correlate with the Knapp conglomerate farther west according to Willard (1936, p. 572) who has stated that the Griswolds Gap and Knapp conglomerates occupy much the same stratigraphic position.

At two localities a rather prolific fossil bed (pl. 3) was observed about 285 feet below the conglomerate contour datum of Plate 1. One of these (located in Tamarack quadrangle along Drury Run road 2000 feet north of the Tamarack fire tower road) is a fine-grained, brown, limonitic, sandstone with a few scattered quartz pebbles up to one-tenth inch long containing abundant *Rhipidomella huntingdonesis* Girty.[3] At the other locality (Keating quadrangle, near a small gully, along Kettle Creek and about 9700 feet south of the mouth of Summerson Run) is a 6-inch bed of bluish-gray sandy limestone from which the following fossils were identified: *Lingulidiscina newberryi* (Hall), *Spirifer composita* Girty, *Camarotoechia* sp., *Schuchertella chemungensis* Conrad and *Rhipidomella* aff. *R. huntingdonensis Girty*. Reger, in a personal communication, has suggested that these faunal zones may be correlative with the Riddlesburg shale as named and described by him in his paper on the Pocono stratigraphy in the Broadtop Basin of Pennsylvania (1927).

The remainder of the Pocono consists of a succession of fine- to medium-grained, brownish-gray or grayish-brown, micaceous, cross-bedded sandstones, shales and siltstones with an occasional thin bed of red shale or siltstone.

Locally, thin, very calcareous, lenticular sandy layers, sometimes containing shale fragments, calcite crystals and carbonaceous material, are found. The authors believe the term calcareous breccias as applied by White to similar calcareous lenses in another area (White, 1881, p. 62) is very descriptive and quite applicable to those in the Leidy area. The occurrence of angular shale fragments intimately mixed in haphazard fashion in the calcareous sandstone ground mass gives the rock a breccia-like appearance. The calcareous lenses are sometimes found immediately above a shale identical with the shale fragments of the breccia. It appears, therefore, that the shale bed has been reworked, broken into fragments which are then deposited in the next overlying layer. The calcareous sandy layers weather with a reddish-brown pitted surface.

Some of the calcareous units are bluish-gray in color and are true sandy limestones. The surface of the limestone weathers to a soft, granular dark-brown or blackish (limonitic? and/or manganiferous?) mass, which spalls off leaving a rounded, very hard, dense limestone core. When these calcareous sandstone and sandy limestone layers were first found it was thought they might be of some value for correlation purposes. It appears, however, that they are extremely lenticular and frequently disappear in a distance of a few tens of feet. Regional studies may show they occur in more or less restricted zones and it is possible they could have some correlative value.

Although the top of the Pocono group was not found in any of the measured sections, other observations indicate the total thickness to be about 570 feet in the Leidy area.

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[3] Paleontologic determinations here and elsewhere by C. E. Prouty, Associate Professor of Geology, University of Pittsburgh, and Cooperating Geologist, Pennsylvania Topographic and Geologic Survey.

Upper Devonian Series

Oswayo Formation. In northeastern Pennsylvania, Willard (1946, p. 789) has placed the top of the Devonian system at the top of the Mount Pleasant red shale. He has traced this red shale from its type locality in the northeastern part of the state, across northern Pennsylvania to north-central Potter County. The top of the concealed interval containing red soil and shale float at 615.2 feet in the Mill Run section, the top of the 8.9 feet of red and green shale at 511.6 feet in the Hyner section, and the top of the 9.7 foot concealed interval containing red soil and shale float at 425.3 feet in the Summerson Run section may be correlative with the Mount Pleasant. In the Kettle Creek section, the top of the Oswayo has been placed at 441.2 feet where a thin bed of greenish-gray shale was observed.

Although the boundary between the Oswayo and the overlying Pocono is based in this report on the red or greenish-gray strata, it should be pointed out here that, if the thin pebble beds discussed under the Pocono group do represent the Griswold Gap conglomerate (basal Pocono), perhaps the top of the Oswayo should be placed higher in the section. If this is true, possibly the top of the Mount Pleasant red shale is represented in the Mill Run section at approximately 472 feet, at the top of a concealed interval above a thin shale bed. Similarly, in the Hyner View section this horizon may be at 375.7 feet, which is the top of an olive-drab, brownish-red, and brownish-gray interval.

The first alternative suggested by the authors, placing the top of the Oswayo at the lower level, affords a better correlation with the horizon used in the East Fork-Wharton area (Ebright, et al., 1949, p. 7) than does placing it just below the Griswold Gap conglomerate. Also, there appear to be more abundant red beds (Mount Pleasant?) in the upper Oswayo if this lower correlation is used.

Lithologically, it is difficult to distinguish between the fine- to medium-grained, gray sandstones and gray shales of the Oswayo and those of the Pocono. No coarse-grained or pebbly sandstones were observed in the Oswayo, but several small lenses of calcareous breccia or sandy limestone, similar to those of the Pocono are present.

The lower limit of the Oswayo formation has been placed at the level where the color of the strata becomes the predominantly red of the Catskill facies. Delimited in this manner, the Oswayo has an average thickness of 308 feet.

Catskill Red Beds. The Catskill facies is a succession of sandstones, siltstones, and shale, predominantly red, with a few interbedded gray and green beds. The sandstones are fine- to medium-grained, micaceous, cross-bedded, and often thin-bedded or flaggy. As compared with the Pocono and Oswayo sandstones, those in the Catskill are usually less resistant to erosion and form fewer prominent terraces or benches. The non-red Catskill sandstones are frequently greenish-gray rather than brownish-gray. The concealed gentle slopes between the sandstones are probably occupied by shales, but, where observed, the shales are often silty to sandy. Calcareous beds, similar to those described in detail under the Pocono group, are also present.

The central part of the Catskill section appears to be more sandy than the upper and lower parts (see columnar section, pl. 3). Approximately the lower 180 feet of this sandy zone is principally greenish-gray in color, whereas the portions of the section above and below are predominantly red.

Although both the upper and lower limits of the Catskill are transitional, the top contact with the Oswayo appears to be the sharper. As stated above, the boundary between the Oswayo and Catskill is placed at the top of the fairly continuous red beds below and the predominantly gray beds above. The only measured section encountering the base of the Catskill is the Oxbow Bend section. Here the lower limit is tentatively placed at 1464.2 feet, the base of the fairly continuous red; thus delimited, the Catskill is 839.4 feet thick. A few fragments of Ostracoderm plates, probably *Pterichthys,* (lower Catskill or upper Chemung) were observed at about 25 feet above this level. Although drawing the base at 1464.2 feet assigns these fossils to the basal Catskill, it is believed that the base of the reds represents a more suitable horizon for drawing the boundary between the Catskill and Chemung rather than at the highest fossil bed.

Chemung Facies. Strata of the Chemung facies are exposed in Kettle Creek valley and its tributaries near the village of Leidy. These consist of alternating beds of fine- to medium-grained, greenish-gray, usually thin-bedded sandstones and greenish-gray shales. Reddish layers occasionally occur in this interval but these become less prominent lower in the section. Ostracoderm plates were found in a fine-grained bluish-green sandstone along the temporary road to the O. Repetto well (OR-1) and in a greenish-gray sandstone along Spicewood Run, about 900 feet upstream from the C. Summerson (CS-1) drilling site. About 400 feet upstream from the Summerson well site, *Lingula* aff. *spatulata* Vanuxem and *Lingula* aff. *L. aherni* were identified in a red sandy siltstone. Another fossil zone is located along Hevner Run approximately 1300 feet from its mouth, in a fine-grained greenish-gray calcareous sandstone. This zone contains *Camarotoechia contracta* (Hall), *Cyrtospirifer disjunctus* (Sowerby) and a few crinoid stems. The above-named fauna are probably of upper Chemung age but may possibly be lower Catskill.

Many of the brachipods in the Chemung have been replaced by limonite; the greenish-gray sandstones in which these fossils are imbedded contain numerous flecks of limonite, some of which are probably altered shell fragments. These limonite flecks seem to be diagnostic of part of the Chemung strata in the Leidy area.

The thickness of the Chemung is not known, as only the upper part is present at the surface, and subsurface studies of the Upper Devonian have not been made. Approximately 200 feet of Chemung strata are exposed at the surface.

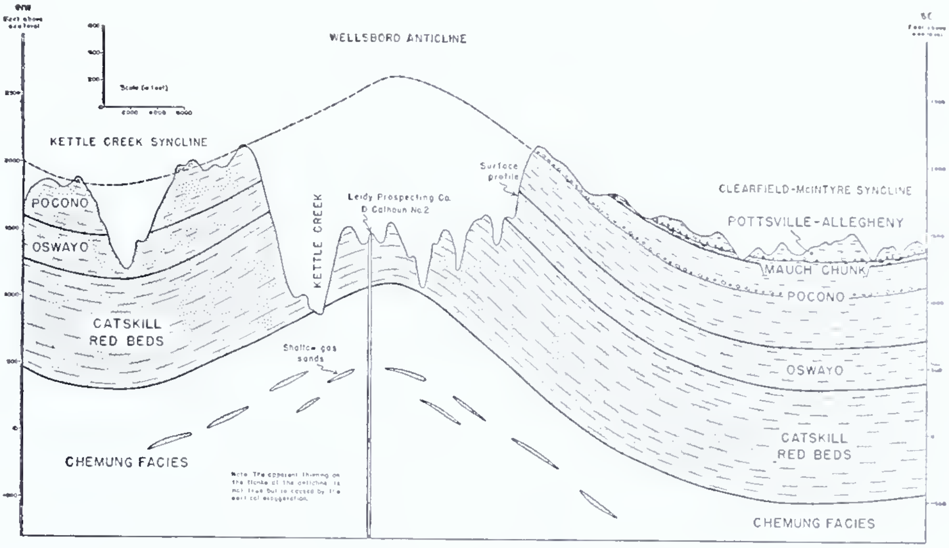

FIGURE 2. Geologic cross section across the Wellsboro anticline at the Leidy gas field.

STRUCTURE

SURFACE

The major structural features of the area are the Wellsboro anticline with its structural culmination—the Leidy dome, the Kettle Creek syncline and the Clearfield-McIntyre syncline. These folds trend predominantly northeast-southwest, more or less parallel to similar structures in this part of the Allegheny Plateau.

The surface closure of the Wellsboro anticline in the Leidy dome area is about 200 feet. As defined by the 2400-foot contour, the lowest closing contour, the dome is 15 miles long and 3 miles wide. There is a low structural saddle to the northeast in Stewardson Township, as indicated by top of Catskill red bed data; to the southwest, however, continual southwest plunge was found to the limits of this field investigation.

The width of the anticline, from syncline to syncline, is approximately 10 miles. Measured by its width here, the Wellsboro structure is among the largest in the northern Allegheny Plateau region. Like many other anticlines of northern Pennsylvania, the Wellsboro structure is asymmetric to the southeast. Plate 1 and Figure 2 show this asymmetry and the difference in the length of the limbs of the fold, the southeast limb being about 1½ times the length of the northwest. Sherrill (1934, p. 237), however, has pointed out that regional studies of the Wellsboro anticline reveal it to be distinctive among northern Pennsylvania folds in that the northwest flank is the longer of the two as often as the southeast is the longer, and the asymmetry varies accordingly along its trend.

The long southeast flank of the anticline, together with the steeper dips of this limb, has carried the strata relatively deeper (800± feet) on the southeast than on the northwest. Considerable more section has been preserved from erosion in the southeast; hence, Pottsville and Allegheny strata are present down the southeast limb of the Wellsboro anticline, while the youngest strata found on the northwest limb are Pocono of Mississippian age (fig. 2).

The relatively deeper position of the Clearfield-McIntyre syncline may be due to (1) differential subsidence, (2) differential deformation, (3) primary dip, (4) tilting, or a combination of these factors. None of these factors can be excluded, but primary dip or tilting appear to be the more reasonable explanations of the discordance in the depths of the two synclines.

The anticline plunges northeast and southwest away from the Leidy dome, site of the Leidy gas field. Cathcart (1934, p. 10) has shown that in the Allegheny Plateau region, domes are frequently associated with sharp bends in an anticlinal axis; the Leidy dome has a similar relationship to a bend in the axis of the Wellsboro anticline. A somewhat anomalous relation is the location of the axis of the anticline in Leidy Township, (pl. 1). It is shown here closer to the north flank than to the south flank, which is just the opposite of the relationship to be normally expected from the asymmetry of the fold. Evidence for locating the axis is apparent from the map data; the 2½ degree southeast dip on Hevner Run, Leidy Township, is critical in determining the axial position. This strike-dip measurement is rated second class and was rechecked twice; there is always the possibility, of course, that the measured strata were cross-bedded.

Regionally, the Wellsboro structure extends many miles to the northeast through Tioga and Bradford counties into adjacent areas in New York (Cathcart, 1934, fig. 2). To the southwest, however, in Grove Township, Cameron County, the present study indicates the structure turns rather sharply to the south-southwest, almost paralleling a similar bend in the axis of the Marshlands anticline (Ebright et al., 1949, pl. 1). Previous reconnaissance investigations (Cathcart, 1934, fig. 2) showed the Wellsboro anticline to be continuous with an anticline passing through Gibson, Benezette, and Lawrence townships in Cameron, Elk, and Clearfield counties, respectively. The authors believe this latter structure to be *en échelon* north of the Wellsboro anticline. This relationship cannot be shown on the map, Plate 1, as it is based on data both adjacent to, and some miles from the southwest edge of the map. The current study further suggests that the Wellsboro structure, heretofore regarded as *en échelon* with the prominent Chestnut Ridge anticline (Cathcart, 1934, p. 13; 1950, p. 1), may actually be equivalent to, and a continuation of the Chestnut Ridge structure. The aforementioned rather sharp deviation of the Wellsboro anticline to the south-southwest shows the trend of the structure to be headed toward the Chestnut Ridge anticline as located by Cathcart in central Gibson Township, Cameron County, and Girard and Goshen townships, Clearfield County. Additional geologic work in northern Clearfield and southern Cameron counties, however, will be required to check this possibility.

STRUCTURE

Unpublished data gathered in connection with the East Fork-Wharton gas field study (Ebright et al., 1949) indicates the southwest plunge of the Marshlands anticline, the next upfold to the northwest of the Wellsboro anticline, to be structurally complicated with numerous reversals of dip. These anomalies were especially noticeable in Lumber and Gibson townships, Cameron County, in the vicinity of Sinnemahoning Creek. Similarly, reconnaissance data gathered in connection with the current study along the southwest plunge of the Wellsboro anticline, in the Sinnemahoning Creek area beyond the west edge of Plate 1, indicate numerous irregularities in strike-dip data. These two anomalous areas, both found on the southwest plunge of the two anticlines, appear to be aligned northwest-southeast, more or less parallel to Sinnemahoning Creek and also closely coincident with the so-called "Kinzua-Emporium cross anticlinal" as described by Ashburner and Sheafer (1880, 1885). Although there is much doubt of the existence of a true cross anticline (Cathcart, 1934, p. 7), the current studies and those of Ashburner and Sheafer indicate a structurally irregular trend of considerable northwest-southeast extent.

Both the Kettle Creek and Clearfield-McIntyre synclines trend more or less parallel to the Wellsboro anticline. Each syncline has closed structural lows within the map area. Dips become very flat toward the synclinal axes, especially in the Clearfield-McIntyre structure. The cross section and the map (fig. 2 and pl. 1) show the bottom of the Clearfield-McIntyre syncline to be approximately 800 feet deeper than the bottom of the Kettle Creek syncline. The effect of the depth of the two synclines on the amount of section that has been preserved in the two areas has previously been mentioned.

An interesting relationship between the Clearfield-McIntyre syncline and the Wellsboro anticline is that a line drawn approximately normal to the general structural trend through the apex of the bend in the axis of the Wellsboro anticline, Leidy Township, also passes through the apex of a similar bend in the axis of the Clearfield-McIntyre syncline (Noyes Township). Similarly, a second normal through the structural low in the Clearfield-McIntyre syncline passes through the structural low in the Kettle Creek syncline. These relationships may be purely chance, or on the other hand, they may have some genetic or tectonic significance. Ashley (1906-08, pp. 213-217; 1911, p. 73) has discussed the relation of structural highs and lows in anticlinal and synclinal areas of central Pennsylvania.

On the southeast flank of the Wellsboro anticline, a number of 7 to 10 degree dips were observed, but these are confined almost exclusively to a broad belt of closely-spaced contours as shown on Plate 1 and the dips probably indicate the local steepening of the strata in this trend.

A closed structural low (2100 foot contour, pl. 1) in Stewardson Township is suggested, although no southeast dips, opposite to the main northwest dip, were observed. The Pocono key bed data and spacing of the contours in the area suggest a possible low.

The termination of two structures—Blossburg syncline and Slate Run anticline—is shown in Chapman Township, Clinton County (southeastern part of pl. 1). The location of these structures differs from that previously shown (Cathcart, 1934, fig. 2), but data to the east of the map indicate that both the anticline and syncline deviate sharply to the south as shown. Both structures terminate approximately at the head of the south-plunging arrows (pl. 1) near the axis of the Clearfield-McIntyre syncline.

Several east to southeast dips in the Tamarack quadrangle, one along a road just northeast of Carey Run, Leidy Township, and the other on the east side of Kettle Creek, Leidy Township near Oriskany test LJ-1, may indicate a subsidiary high on the northwest flank of the Wellsboro anticline. These two strike-dip measurements, however, were considered poor third-class data, and both are in an area where the dip is predominantly northwest.

Chance and Ashburner (1880, pl. 7) show their "synclinal axis first bituminous coal basin" trending N 52° E through the Renovo West and Tamarack quadrangles. Their "axis" crosses Shintown and Drury Runs approximately 2.2 miles northwest of the Clearfield-McIntyre syncline. No evidence for such a syncline was found in the current study. It is believed that this so-called "first bituminous coal basin" is based on erroneous coal correlations.

No definite evidence of surface faulting was found on the Wellsboro anticline. In Stewardson Township, however, along the extreme north edge of the map, Plate 1, and just to the northwest of the axis of the Kettle Creek syncline, a possible fault was observed in an outcrop on the west bank of Cross Fork Creek. The beds here appear to be severely fractured but neither a fault plane nor stratigraphic displacement could be determined with certainty. Various areas of relatively steep dips on the northwest flank of the anticline may represent the surface expression of subsurface faulting; along Right Fork of Beaverdam Run two dips of 8 and 9 degrees were measured, a 10 degree dip was observed along Walters Run and 7 to 8 degree dips were found along Elm Camp Run. In Kettle Creek Valley, northeast of Cross Fork, Stewardson Township, a number of 6 to 7½ degree measurements, roughly in alignment, are suggestive of faulting or flexing. Although it is reasonable to assume that subsurface faulting may be reflected in local steepening of dips or displacement in the surface beds, such data must be used with caution. The highly cross-bedded nature of much of the strata exposed in the area together with the limited extent of many outcrops frequently make it difficult to determine if anomalous dips indicate structure, or are merely cross-bedded strata.

SUBSURFACE

An interpretation of the subsurface structure on the top of the Oriskany sandstone, based on the data available to February 1951, is shown on the map, Plate 2. Obviously, since subsurface information is now lacking in much of the area, the structural details of the deeper beds over large parts of the dome are unknown.

STRUCTURE

An elongated, domal-shaped outline, similar to the surface structure, is suggested by the Oriskany contours. The dip down the northwest flank of the dome is well established and southeast to south dip on the opposite flank is shown by several wells in the southern portion of the field. The plunge of the dome along the trend is as yet only vaguely suggested. The dip of the northwest flank appears to be approximately twice the amount of the surface dips.

By comparison of Plates 1 and 2, it can be seen that the Oriskany axis just southeast of Leidy is shifted to the northwest from the axis as developed on the surface beds. Although there is insufficient data to determine the overall relation of the Oriskany axis with that shown by the surface, the regional convergence of the Mississippian-Devonian section westward would cause shifting of the Oriskany axis to the west and northwest of the surface axis. Perhaps equally important in causing this shift may be regional southeastward tilting, primary dip to the southeast, or faulting. As mentioned previously, evidence for such tilting or primary dip is suggested by the rather large discordance in the depth of the Clearfield-McIntyre syncline and the Kettle Creek syncline, the former being 800± feet deeper than the latter. The possibility of faulting is described elsewhere in this report.

Considering the effect of convergence on axial shift, if the convergence is erratic, the shift of the axes will be equally erratic. For example, the Tully-Oriskany interval is quite irregular, ranging from 797 to 881 feet in the wells now completed, and the subsurface structure may correspondingly change with respect to that shown by the surface. Some of the variations in the Tully-Oriskany interval may be attributable to the cutting of faults (see fault discussion below) or steeply-dipping beds adjacent to faults. The Tully is an excellent marker bed and is a guide to the operator in determining the depth to the Oriskany sand and the relative structural position of a drilling well with respect to others. Thickness variations, however, between these two units, whether structural or stratigraphic, will cause a change or even a reversal of structure between that shown by the Tully and that shown by the Oriskany. A good illustration of this is provided by the R. P. Daugherty No. 1 well (RD-1 on map) and the H. Finnefrock No. 1 well (HF-1). The Daugherty test is 7 feet higher on the Tully than the Finnefrock, but, because of thinning of the Tully-Oriskany interval between the two tests, Finnefrock found the Oriskany 8 feet higher than in the Daugherty test.

The major anticlinal trends of northern Pennsylvania and southern New York are also trends of faulting (Finn, 1949, pp. 314-315). It is highly probable, too, that faults are present in the Leidy area. On the map, Plate 2, a subsurface fault, upthrown to the south, is suggested between the J. Calhoun No. 2, well (JC-2) and the E. Summerson No. 1 well (ES-1), the fault being based on the (a) relatively high position of the E. Summerson test and (b) the discordance of gas-water levels between E. Summerson and W. Summerson No. 1 (WS-1, approximately 9000 feet east-northeast of Hammersley Fork). E. Summerson No. 1 is 103 feet higher than W. Summerson No. 1 but the former obtained salt water in the Oriskany while the latter was gas productive. Such discordant relationships may be attributable to faulting or, alternatively, to stratigraphic factors.

Five wells in the southwestern part of the presently-developed field—J. Calhoun No. 1 (JC-1), C. Cross No. 1 (CC-1), F. Pelkey No. 1 (FP-1), D. Calhoun No. 1 (DC-1), and H. Summerson No. 1 (HS-1)—have Tully-Oriskany intervals ranging from 868 to 881 feet, which appear to be somewhat larger than normal. As the first four above-named wells are roughly in alignment, it is possible the thickened sections are attributable to (a) cutting a fault or (b) drilling through steepened beds near a fault.

If faults are present in the subsurface in the areas suggested above, they are not apparent on the surface. This may be due to: (1) faulting which took place prior to the deposition of surface and near surface beds, and not reflected in surface beds, (2) the energy-absorbing action of the thousands of feet of incompetent Devonian shales that may have dissipated deeper movements, and (3) the lack of outcrops so that displacement was not observed on the surface.

The abrupt flattening of dip (pl. 2) between W. Summerson No. 1 (WS-1) and C. Foley No. 1 (CF-1), both on the northwest flank of the dome, may indicate a subsidiary high or perhaps faulting. The Oriskany dip between the two wells is about the same as the surface dip, although subsurface data in other parts of the field indicate a much sharper dip in the Oriskany than in the surface beds. As noted in the description of surface structure, several east to southeast dips were found in this area of flattened dips, but there was no conclusive evidence of a surface structural high.

DESCRIPTION OF THE LEIDY ORISKANY SAND GAS FIELD

The Leidy Oriskany sand gas field is located on the Leidy dome of the Wellsboro anticline. Data for the 64 wells completed or located by the middle of February, 1951 are given in the Appendix on pages 24 to 25. To date the producing area is approximately 3½ miles long and 2½ miles wide.

The Oriskany sand in the various completed wells is encountered at depths ranging from 5587 to 6533 feet below the surface. Gas is usually obtained in the upper few feet of the sand. C. R. Fettke[4] has examined and described the lower 58 feet of samples from the C. Foley No. 1 well (CF-1). In this well the Oriskany sand is fine- to medium-grained, light-gray, quartzose and contains a few rounded and frosted quartz grains up to 1.5 millimeters in diameter. At 4 feet below the top of the sand, the Oriskany becomes somewhat calcareous, and a few rounded quartz grains show secondary crystal faces. Directly overlying the Onondaga limestone is a 2-foot bed of grayish-brown, bentonitic, in part micaceous, shale containing minutely disseminated pyrite. This thin bentonitic shale probably represents the Tioga bentonite which was first recognized in drill cuttings from the Tioga gas field in Tioga County, Pennsylvania (Fettke, 1931, p. 8). It was also described by Fettke in the East Fork-Wharton gas field (Ebright, et al., 1949, p. 10) and in other areas. The Onondaga limestone in the Foley well consists of an upper 8 feet of coarse, clastic, argillaceous gray limestone containing abundant fragments of small shells and a lower 6 feet of gray to very dark gray, in part calcareous, shale containing an occasional rounded quartz grain and a little glauconite. In the E. Summerson No. 1 well (ES-1A), the only well thus far drilled through the Oriskany, the sand has a total thickness of 32 feet.

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[4] Professor of Geology, Carnegie Institute of Technology, and Cooperating Geologist, Pennsylvania Topographic and Geologic Survey.

A core-analysis of several small fragments of sand, blown from the W. Summerson No. 1 well (WS-1), was made by E. M. Tignor.[5]

The results[6] of this analysis are as follows:

SAMPLE NUMBER	POROSITY *Per cent*	PERMEABILITY *Millidarcies*
1	8.35	15.7
2	8.09	(sample broke in mounting)
3	8.58	6.1

Because these samples were blown from the well by gas flow, it is impossible to determine the part of the sand from which they came. It is possible that they might not be representative of the reservoir sandstone.

The initial open flow volumes of the producing wells completed thus far have varied from 270,000 cubic feet to about 145,000,000 cubic feet of gas per day. The latter production was obtained from New York State Natural Gas Corp., H. Finnefrock No. 1 (HF-1), believed to be the largest gas well ever discovered east of the Mississippi River. Initial reservoir pressures in the field have ranged from 2660 to 4200 pounds per square inch.

An anomalous feature of the Leidy Oriskany field is the high pressures which have been encountered in the Oriskany sand. These are considerably more than is expected from the depth of sand. Four reasons are commonly given to explain abnormally high pressures in oil and gas wells: (1) Cementation of the sand subsequent to the accumulation of gas, thereby reducing the pore volume and increasing the pressure; (2) Compaction of the sand due to weight of the overburden; if this compaction occurs subsequent to the accumulation of gas, the pore volume will be decreased and gas pressure will increase; (3) High pressures are inherited from periods of deeper burial of the sand; if uplift of the strata occurs after gas accumulation, it is possible that the original higher pressures may be maintained; (4) Leakage of high pressure gas through fissures from sources below the Oriskany. In the case of the Leidy field, nothing that is known about the geology of this field precludes any one or combination of the above four factors from being operative in the creation of abnormally high pressures.

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[5] Petroleum Engineer, U. S. Bureau of Mines, Petroleum Field Office, Franklin, Pa.

[6] Published by permission of the Director, Bureau of Mines, U. S. Department of the Interior.

Leidy Gas Field

The large initial open flow capacities of some of the Leidy Oriskany wells and the great difference in production between New York State Natural Gas Company, R. Daugherty No. 1 (RD-1) and H. Finnefrock No. 1, suggests that porosity in the Oriskany may be due in part to fractures. Finnefrock No. 1 is only 1800 feet east of and 8 feet higher on the Oriskany than Daugherty No. 1, yet the Finnefrock test had an initial open flow 3 times that of the Daugherty test. It appears likely that fissures associated with faulting may account for some of the Oriskany porosity.

All wells in the Leidy pool have been drilled with cable tools. Footage drilled in 24 hours has ranged from only a foot or two in the hardest formations to over 100 feet in the softest strata. Drilling is done with about ½ barrel of water in the hole. A standard 84-foot steel derrick is used. The hole is started with a 12-inch bit and about 50 feet of 10¾-inch casing are run. Inside this casing a 9-inch bit is used to about 450 feet where 8⅝-inch casing is set and cemented in place. Continuing from there to the Onondaga limestone with an 8¼-inch hole, a 7-inch O. D. casing is set and cemented in the top of the limestone before the Oriskany sand is drilled. A safety drill head is used in drilling the Oriskany. Wells are equipped with Christmas trees with 6000 pounds tested connections, and all three strings of casings are left in the producing wells. When a well is abandoned, a lead plug is set and cemented in the Onondaga. Another plug is placed below the 8⅝-inch casing.

Three pipelines—a 16 inch, an 8 inch, and a 5 inch—are taking gas from the field.

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APPENDIX

Page
WELL RECORDS 24
MEASURED SECTIONS 26
  Kettle Creek Section 26
  Mill Run Section 29
  Oxbow Bend Section 31
  Summerson Run Section 32
  Hyner View Section 33

Map No.	Company	Tract and Well No.	Township	Quadrangle	Location	Elevation	Tully	Onondaga	Oriskany	Total Depth	Completed	I.O.F. /Day* 1000 Cu. Ft.	Initial** Reservoir Pressure	Other Shows
CB-1	Pittsburgh Oil and Gas Co.	C. Brooks 1	Leidy	Hammersley Fork	1.75 mi. S 41° 27' 30" .94 mi. W 77° 52' 30"	1039								
DC-1	Leidy Prosp. Co.	D. Calhoun 1	Leidy	Hammersley Fork	.63 mi. S 41° 25' .17 mi. W 77° 55'	928	4840-	5635-	5659-	5662	1-3-50	15,000 Est.	4200	
DC-2	Leidy Prosp. Co.	D. Calhoun 2	Leidy	Hammersley Fork	.46 mi. S 41° 25' 2.0 mi. W 77° 52' 30"	1478	5373-5485	6157-	6172-	6172	6-29-50	38,000	3950	
DC-3	Leidy Prosp. Co.	D. Calhoun 3	Leidy	Hammersley Fork	.88 mi. S 41° 25' 2.09 mi. W 77° 52' 30"	1123	4942-5067	5768-	5823-	5825	1-17-51	7,200	3180 in 14 hrs.	
DC-4	Leidy Prosp. Co.	D. Calhoun 4	Leidy	Hammersley Fork	.49 mi. S 41° 25' 1.67 mi. W 77° 52' 30"	1500								
EC-1	Appalachian Dev.	E. Calhoun 1	Leidy	Hammersley Fork	2.58 mi. S 41° 27' 30" 1.79 mi. W 77° 52' 30"	1001								
JC-1	O. L. Cabot Inc.	J. D. Calhoun 1	Leidy	Hammersley Fork	1.45 mi. S 41° 25' .73 mi. W 77° 55'	1051	4936-5051	5781-5804	5804-	5804?	7-1-50	8,740	4100 in 12 hrs.	
JC-2	G. L. Cabot Inc.	J. D. Calhoun 2	Leidy	Hammersley Fork	1.46 mi. S 41° 25' .19 mi. W 77° 55'	861	4833-4952	5636-	5658-5678	5687	12-7-50	270	4075 in 48 hrs.	
JC-4	G. L. Cabot Inc.	J. D. Calhoun 4	Leidy	Hammersley Fork	1.12 mi. S 41° 25' .9 mi. W 77° 55'	1431								
LC-1	D. Calhoun et al.	L. Calhoun 1	Leidy	Hammersley Fork	2.18 mi. S 41° 27' 30" 2.01 mi. W 77° 52' 30"	911								Gas at 675
MC-1	N. Y. S. Nat. Gas	M. Calhoun 1	Leidy	Hammersley Fork	.01 mi. S 41° 25' 1.63 mi. W 77° 52' 30"	924								500 M Gas at 430,443,445
AC-1	Keta Gas & Oil Co.	A. Carlson 1	Leidy	Hammersley Fork	.15 mi. S 41° 25' .51 mi. W 77° 55'	923								
SC-1	N. Y. S. Nat. Gas	Sophia Cole 1	Leidy	Hammersley Fork	2.36 mi. S 41° 27' 30" 1.24 mi. W 77° 52' 30"	1216								
EC-1	N. Y. S. Nat. Gas	E. Connell 1	Leidy	Hammersley Fork	.74 mi. S 41° 25' .53 mi. W 77° 55'	940	4881-4990	5671-	5695-	5697	10-11-50	18,500	3900	
EC-2	N. Y. S. Nat. Gas	E. Connell 2	Leidy	Hammersley Fork	.41 mi. S 41° 25' .6 mi. W 77° 55'	1358								
CC-1	Keta Gas and Oil	C. Cross 1	Leidy	Hammersley Fork	1.21 mi. S 41° 25' .47 mi. W 77° 55'	904	4771-	5622-	5650-	5652	1-17-51	10,000	3180	
GC-1	N. Y. S. Nat. Gas	George Cross 1	Leidy	Hammersley Fork	.65 mi. S 41° 25' 1.76 mi. W 77° 52' 30"	1558								
ED-1	N. Y. S. Nat. Gas	E. Daugherty 1	Leidy	Hammersley Fork	.32 mi. S 41° 25' 1.45 mi. W 77° 52' 30"	1642	5491-							
FD-1	Roeder and White	F. Daugherty 1	Leidy	Tamarack	1.83 mi. S 41° 27' 30" 1.9 mi. W 77° 50'	1405								
RD-1	N. Y. S. Nat. Gas	R. P. Daugherty 1	Leidy	Tamarack	1.91 mi. S 41° 27' 30" 1.69 mi. W 77° 50'	1479	5272-	6066-	6086-	6086?	8-3-50	50,000	4100 in 48 hrs.	
TD-1	Mid-Atlantic Oil and Gas	Theo. Daugherty 1	Leidy	Tamarack	1.88 mi. S 41° 30' 1.89 mi. W 77° 47' 30"	1030								
HF-1	N. Y. S. Nat. Gas	H. E. Finnefrock 1	Leidy	Tamarack	2.02 mi. S 41° 27' 30" 1.38 mi. W 77° 50'	1736	5536-5640	6315-	6335-	6335?	2-2-51	145,000	3650	
CF-1	G. L. Cabot Inc.	C. Foley 1	Leidy	Tamarack	2.0 mi. S 41° 30' 1.19 mi. W 77° 50'	1338	5679-	6512-	6533-	6542	10-6-50	300' SW in 1 hr. D & A		
PF-1	Shaw and Smith	P. Foley 1	Leidy	Tamarack	2.69 mi. S 41° 27' 30" .37 mi. W 77° 50'	1680								
LG-1	Renovo Gas and Oil	L. Green 1	Leidy	Tamarack	2.03 mi. S 41° 30' 1.39 mi. W 77° 47' 30"	1165								
HHC-1	Mid-Atlantic Oil and Gas	Homewood Hunting Club 1	East Keating	Keating	1.5 mi. S 41° 22' 30" 1.81 mi. W 77° 57' 30"	1503								Gas at 800
LJ-1	G. L. Cabot Inc.	L. Jacobus 1	Leidy	Tamarack	.55 mi. S 41° 27' 30" 1.35 mi. W 77° 50'	1292								
CJ-1	Appalachian Dev.	C. Johnston 1	Leidy	Tamarack	1.35 mi. S 41° 27' 30" .14 mi. W 77° 50'	1758								100 M Gas at 1130
AK-1	N. Y. S. Nat. Gas	A. Kelly 1	Leidy	Tamarack	1.55 mi. S 41° 27' 30" 1.08 mi. W 77° 50'	1610								
KHC-1	D. Calhoun et al.	Keystone Hunting Club 1	Leidy	Hammersley Fork	2.42 mi. S 41° 27' 30" 2.01 mi. W 77° 52' 30"	913								
KRG-1	Kiski Rod and Gun Club	Kiski Rod and Gun Club 1	Steward-son	Short Run	.07 mi. S 41° 32' 30" 1.93 mi. W 77° 45'	1263								
LK-1	N. Y. S. Nat. Gas	L. Kunkle 1	Leidy	Tamarack	1.23 mi. S 41° 27' 30" .76 mi. W 77° 50'	1675								
JL-1	G. L. Cabot Inc.	J. J. Leban 1	Leidy	Tamarack	.18 mi. S 41° 27' 30" 1.42 mi. W 77° 47' 30"	1744								
HL-1	Roeder and White	H. Ludy 1	Leidy	Hammersley Fork	.11 mi. S 41° 25' .54 mi. W 77° 55'	903	5123-	5904-5925	5925-	5925	8-15-50	3,020	3950 in 48 hrs.	
HM-1	E. P. Sheridan	H. Martin 1	Leidy	Tamarack	1.82 mi. S 41° 25' 1.67 mi. W 77° 45'	1747								
JM-1	Noyley Dev.	J. McCoy 1	Leidy	Hammersley Fork	.76 mi. S 41° 25' .38 mi. W 77° 55'	939	4852-	5650-	5676-	5677	9-29-50	16,500	3975 in 24 hrs.	
RM-1	Wade	R. B. McCoy 1	Leidy	Hammersley Fork	.88 mi. S 41° 25' .29 mi. W 77° 55'	873	4757-4869	5557-	5587-	5588	1-19-51	7,500	3100 in 24 hrs.	
VM-1	D. Calhoun et al.	V. McCoy 1	Leidy	Hammersley Fork	1.15 mi. S 41° 25'									

WELL RECORDS

Map No.	Company	Tract and Well No.	Township	Quadrangle	Location	Elevation	Tully	Onondaga	Oriskany	Total Depth	Completed	I.O.F. /Day* 1000 Cu. Ft.	Initial** Reservoir Pressure	Other Shows
FP-1	Noyley Dev.	F. Pelkey 1	Leidy	Hammersley Fork	1.03 mi. S 41° 25' .33 mi. W 77° 55'	867	4734-4846	5583-	5607-	5613	1-17-51	6,400	2660 in 14 hrs.	
Pa-1-1	N. Y. S. Nat. Gas	State of Pa. 1 Tract 1	Grove	Keating	.67 mi. S 41° 22' 30" 1.96 mi. W 77° 57' 30"	1770								
Pa-1-2	N. Y. S. Nat. Gas	State of Pa. 1 Tract 2	East Keating	Hammersley Fork	2.7 mi. S 41° 25' 1.14 mi. W 77° 57' 30"	1598								Gas at 756
Pa-1-4	N. Y. S. Nat. Gas	State of Pa. 1 Tract 4	Leidy	Hammersley Fork	1.47 mi. S 41° 25' 1.45 mi. W 77° 55'	1108								
Pa-1-5	Appalachian Dev.	State of Pa. 1 Tract 5	Leidy	Hammersley Fork	.9 mi. S 41° 25' .75 mi. W 77° 55	1205								
Pa-2-5	Appalachian Dev.	State of Pa. 2 Tract 5	Leidy	Hammersley Fork	1.09 mi. S 41° 25' 1.19 mi. W 77° 55'	1446								
Pa-3-5	Appalachian Dev.	State of Pa. 3 Tract 5	Leidy	Hammersley Fork	1.45 mi. S 41° 25' 1.19 mi. W 77° 55'	927								
Pa-1-6	Pipeline Constr. and Drilling	State of Pa. 1 Tract 6	Leidy	Tamarack	2.19 mi. S 41° 27' 30" 2.06 mi. W 77° 50'	1440								
Pa-2-6	Pipeline Constr. and Drilling	State of Pa. 2 Tract 6	Leidy	Tamarack	1.61 mi. S 41° 27' 30" 1.48 mi. W 77° 50'	1346								
Pa-1-7	Pipeline Constr. and Drilling	State of Pa. 1 Tract 7	Leidy	Hammersley Fork	.09 mi. S 41° 25' 1.01 mi. W 77° 52' 30"	1682								
Pa-19-4920	G. L. Cabot Inc.	State of Pa. 19 Warrant 4920	Wharton	Hammersley Fork	.62 mi. S 41° 30' 2.13 mi. W 77° 57' 30"	2253	5711-	6400-	6422-	6434	7-14-50	1,800 with SW D & A	1000	
Pa-15-4921	G. L. Cabot Inc.	State of Pa. 15 Warrant 4921	Wharton	Hammersley Fork	.04 mi. S 41° 30' 1.71 mi. W 77° 57' 30"	1940	5328-	6016	6028-	6051	11-14-49	21,600	2100	130 M Gas at 480
CP-1	Appalachian Dev.	C. Peters 1	Leidy	Hammersley Fork	1.99 mi. S 41° 27' 30" .75 mi. W 77° 52' 30"	960								
HP-1	N. Y. S. Nat. Gas	H. V. Proctor 1	Leidy	Hammersley Fork	.39 mi. S 41° 25' .08 mi. W 77° 55'	1120	5098-5204	5878-	5899-	5901	12-15-50	13,500	3540 in 20 hrs.	
OR-1	G. L. Cabot Inc.	O. Repetto 1	Leidy	Hammersley Fork	.97 mi. S 41° 25' .45 mi. W 77° 55'	1136		5824-5842	5842-	5843	12-15-50	30,000	3600 in 1 1/2 hrs.	
DHS-1	D. Calhoun et al.	D. H. Schoonover 1	Leidy	Hammersley Fork	.76 mi. S 41° 25' .35 mi. W 77° 55'	900								
DMS-1	G. L. Cabot Inc.	D. M. Schoonover 1	Leidy	Hammersley Fork	.75 mi. S 41° 35' 1.15 mi. W 77° 55'	1286								
ES-1	Leighton and Christman	E. Schoonover 1	Leidy	Hammersley Fork	.75 mi. S 41° 25' .75 mi. W 77° 55'	1007								
HRS-1	G. L. Cabot Inc.	H. R. Stahl 1	Leidy	Hammersley Fork	2.56 mi. S 41° 27' 30" .48 mi. W 77° 55'	1265								
CS-1	N. Y. S. Nat. Gas	C. Summerson 1	Leidy	Hammersley Fork	1.08 mi. S 41° 25' 2.14 mi. W 77° 52' 30"	936	4835-4945	5654-	5680-					
ES-1(A)	Fairman and Miller	E. Summerson 1	Leidy	Hammersley Fork	2.17 mi. S 41° 25' .26 mi. W 77° 55'	954	5052-	5842-	5853-5885	5889	10-3-50	300' of SW in 5 days; D & A		
HS-1	Hopkins and Layton	H. Summerson 1	Leidy	Hammersley Fork	1.77 mi. S 41° 25' .74 mi. W 77° 55'	904	5082-5198	5942-	5960-	5962	11-2-50	SW too much to bail; D & A		50 M Gas at 820
WS-1	Appalachian Dev.	W. Summerson 1	Leidy	Hammersley Fork	1.69 mi. S 41° 27' 30" .66 mi. W 77° 52' 30"	1292	5497-	6281-	6294-	6305	9-22-50	4,100		
CS-1(A)	Blue Rock Drlg.	C. Swartz 1	Leidy	Tamarack	.37 mi. S 41° 27' 30" 1.15 mi. W 77° 47' 30"	1689	5508-5625							
USL-1	Appalachian Dev.	U. S. Lumber Co. 1	Leidy	Tamarack	1.89 mi. S 41° 27' 30" 1.6 mi. W 77° 50'	1586								
USL-2	Appalachian Dev.	U. S. Lumber Co. 2	Leidy	Tamarack	1.67 mi. S 41° 27' 30" 1.23 mi. W 77° 50'	1562								
AW-1	Appalachian Dev.	A. Wykoff 1	Leidy	Hammersley Fork	.24 mi. S 41° 25' .47 mi. W 77° 55'	869	5005-	5788-	5810-	5826	11-2-50	3,000	3950 in 36 hrs.	
FW-1	G. L. Cabot Inc.	F. Wykoff 1	Leidy	Tamarack	1.34 mi. S 41° 27' 30" .21 mi. W 77° 50'	1747	5708-5780							

LEIDY GAS FIELD

MEASURED SECTIONS

KETTLE CREEK SECTION

Base of section begins on east side of Kettle Creek, 7600 feet northwest of mouth of Summerson Run, Leidy Township, Clinton County, Pennsylvania.

Keating 7½ minute quadrangle:

1.07 miles south of Latitude 41° 22′ 30″

2.49 miles west of Longitude 77° 52′ 30″

Measured by A. I. Ingham and J. R. Ebright

THICKNESS FEET	DESCRIPTION OF STRATA	CUMULATIVE THICKNESS IN FEET	
	MISSISSIPPIAN SYSTEM		
	Pocono group, 441.2+ feet.		
30.3	Sandstone, fine- to medium-grained, brownish-gray, thin- to medium-bedded	0	30.3
3.8	Concealed	30.3	34.1
10.8	Sandstone, massively bedded, cross-bedded, coarse-grained to conglomeratic with quartz pebbles up to 1 inch in diameter; pebbles subangular and some elliptical, white, brown, and vari-colored. The base of this conglomerate is the contour datum of the accompanying structure map, Plate 1. A sharp break in slope (steeper below) at 10 feet below this conglomerate (in 96.1 foot concealed interval) may actually be the base of the conglomerate	34.1	44.9
96.1	Concealed	44.9	141
9.7	Concealed, contains red shale float, and red soil—*Patton shale?*	141	150.7
17.3	Sandstone, fine- to medium-grained, brown and brownish-gray, thin- to medium-bedded, cross-bedded	150.7	168
6.5	Similar to unit immediately above, but brownish-red in places	168	174.5
37.8	Concealed with abundant silver birch trees	174.5	212.3
26	Sandstone, fine- to medium-grained, brownish-gray and grayish-brown, thin- to medium-bedded and cross-bedded; flattening of slope at top of this unit	212.3	238.3
1	Shale, brownish-gray, silty, very thin bedded (almost paper thin)	238.3	239.3
4.9	Sandstone, fine- to medium-grained, brownish-gray, predominantly thin-bedded, cross-bedded	239.3	244.2
32.4	Sandstone, fine- to medium-grained, light-brown, thin- to medium-bedded, cross-bedded	244.2	276.6
3.2	Siltstone, brownish-gray, somewhat blocky, fractured on weathered surface	276.6	279.8
2.7	Concealed	279.8	282.5
3.2	Sandstone, very fine-grained, brownish-gray, thin- to medium-bedded, with bedding more parallel than is commonly found in this section	282.5	285.7
17.3	Concealed	285.7	303
2	Siltstone, dark-red, shaly with a few carbonaceous laminae in upper part	303	305
3.2	Concealed	305	308.2
2	Siltstone, greenish-gray, very thin-bedded with more or less parallel bedding planes	308.2	310.2
9.7	Concealed	310.2	319.9
2	Siltstone, greenish-gray, very thin-bedded, fairly parallel-bedded	319.9	321.9
6.5	Concealed with red soil	321.9	328.4
49.2	Concealed	328.4	377.6
3.2	Sandstone, fine-grained, brownish-gray, thin- to medium-bedded	377.6	380.8
40.5	Concealed	380.8	421.3
10.8	Sandstone, fine-grained, grayish-brown, thin- to medium-bedded, cross-bedded	421.3	432.1
5.9	Concealed	432.1	438
3.2	Sandstone, fine-grained, grayish-brown, thin- to medium-bedded	438	441.2

KETTLE CREEK SECTION (continued)

THICKNESS FEET	DESCRIPTION OF STRATA	CUMULATIVE THICKNESS IN FEET	
	UPPER DEVONIAN SERIES		
	Oswayo formation, 309.5 feet.		
0.5	Shale, greenish-gray, hackly-weathered surface	441.2	441.7
15.7	Concealed	441.7	457.4
9.7	Sandstone and shale interbedded; sandstone, fine-grained, grayish-brown, thin-bedded; shale, greenish-gray, in part sandy	457.4	467.1
0.5	Shale, greenish-gray, in part sandy	467.1	467.6
13	Sandstone, fine- to medium-grained, grayish-brown, medium-bedded	467.6	480.6
0.5	Sandstone, fine- to medium-grained, brownish-gray, some shale fragments; rough and pitted on weathered surface	480.6	481.1
0.5	Limestone, bluish-gray, sandy, very hard, dense; this is the purest limestone observed in the section	481.1	481.6
10.8	Sandstone, fine-grained, grayish-brown, thin-bedded, slightly cross-bedded	481.6	492.4
38.9	Concealed	492.4	531.3
18.4	Sandstone, fine-grained, gray and grayish-brown, thin-bedded and rather evenly-bedded	531.3	549.7
33	Concealed	549.7	582.7
15.1	Sandstone, fine-grained, gray and grayish-brown, thin- to medium-bedded, highly cross-bedded	582.7	597.8
20	Concealed	597.8	617.8
20.6	Sandstone, fine-grained, brownish-gray, very thin- to medium-bedded	617.8	638.4
10.8	Sandstone, medium-grained, brown to grayish-brown, thin- to medium-bedded and cross-bedded	638.4	649.2
1	Sandstone, fine-grained, gray, thin- to medium-bedded	649.2	650.2
4.9	Limestone, brownish-gray, impure, sandy, containing up to 1 inch layers of highly calcareous sandstone; limestone weathered surface is rough, highly fractured	650.2	655.1
5.4	Concealed	655.1	660.5
18.4	Sandstone, fine- to medium-grained, brownish-gray, thin- to medium-bedded, cross-bedded	660.5	678.9
40.5	Concealed	678.9	719.4
7.6	Sandstone, fine- to medium-grained, brownish-gray, medium-bedded, this unit and 3.2 foot and 10.8 foot unit below may be slumped	719.4	727
3.2	Sandstone, alternating layers of highly calcareous brownish-gray sandstone and sandstone as in unit immediately above; calcareous sandstone weathers rough, reddish-gray color, and contains possible fossil fragment	727	730.2
10.8	Sandstone, fine- to medium-grained, brownish-gray, medium-bedded, fairly parallel-bedded	730.2	741
5.9	Concealed	741	746.9
3.8	Sandstone, fine- to medium-grained, brownish-gray, rather massive, highly micaceous	746.9	750.7
	Catskill red beds, 437+ feet.		
46.5	Concealed with reddish soil in places	750.7	797.2
2	Sandstone, fine-grained, brownish-gray, thin-bedded, cross-bedded	797.2	799.2
1	Sandstone and shale interbedded; sandstone, fine-grained, greenish-gray; shale, dark-red, silty, highly micaceous	799.2	800.2
17.3	Sandstone, fine- to medium-grained, brownish-gray, thin- to medium-bedded, rather parallel-bedded .	800.2	817.5
6.5	Sandstone, similar to above, but more cross-bedded	817.5	824

KETTLE CREEK SECTION (continued)

THICKNESS FEET	DESCRIPTION OF STRATA	CUMULATIVE THICKNESS IN FEET	
4.3	Limestone, vari-colored, grayish-green and grayish-brown weathering to a reddish-brown, sandy in places, trace of shell fragment, rough and pitted weathered surface; common shale pebbles oval or flat up to 1 inch in diameter; abundant calcite veinlets; about half of the section appears to be reworked	824	828.3
3.2	Sandstone, medium-grained, light-gray, thin-bedded	828.3	831.5
49.2	Concealed	831.5	880.7
18.4	Concealed, reddish soil	880.7	899.1
7.6	Sandstone, fine-grained, brownish-gray, medium-bedded, flaggy	899.1	906.7
3.2	Concealed	906.7	909.9
9.2	Sandstone, fine-grained, grayish-brown, thin-bedded, cross-bedded	909.9	919.1
6.5	Sandstone, fine-grained, highly calcareous, argillaceous in places, lenticular	919.1	925.6
6.5	Sandstone, fine-grained, greenish-gray, thin-bedded	925.6	932.1
20.6	Concealed, slightly red soil	932.1	952.7
15.1	Sandstone, fine- to medium-grained, brownish-gray and grayish-brown, thin- to medium-bedded	952.7	967.8
11.9	Concealed	967.8	979.7
9.2	Sandstone, fine- to medium-grained, reddish-brown, thin-bedded, cross-bedded	979.7	988.9
11.9	Concealed	988.9	1000.8
9.7	Sandstone, very fine-grained, brownish-red, becomes silty near top, very thin-bedded	1000.8	1010.5
13.5	Concealed	1010.5	1024
4.3	Sandstone, fine-grained, brownish-gray, thin- to medium-bedded	1024	1028.3
1	Siltstone, brick-red, sandy, blocky fracture, shaly near top	1028.3	1029.3
12.4	Concealed	1029.3	1041.7
3.2	Siltstone, brick-red, sandy, thin-bedded, cross-bedded; in place(?)	1041.7	1044.9
16.2	Concealed	1044.9	1061.1
5.4	Sandstone, fine-grained, reddish-brown, thin- to medium-bedded, cross-bedded	1061.1	1066.5
6.5	Concealed	1066.5	1073
10.8	Sandstone, medium-grained, gray, medium- to heavy-bedded	1073	1083.8
24.8	Sandstone, same as above but thin- to medium-bedded	1083.8	1108.6
12.4	Sandstone, medium-grained, gray, thin-bedded, cross-bedded	1108.6	1121
5.4	Sandstone, fine-grained, greenish-gray, medium-bedded, cross-bedded	1121	1126.4
1	Sandstone, fine-grained, greenish-gray, highly calcareous, contains dark-gray shale pebbles, and limonite specks	1126.4	1127.4
1	Sandstone, fine- to medium-grained, gray to greenish-gray	1127.4	1128.4
1	Sandstone, fine- to medium-grained, grayish-green, highly calcareous, brown-speckled, a few shale fragments	1128.4	1129.4
3.8	Sandstone, very fine grained, reddish-brown, massive-bedded, somewhat cross-bedded	1129.4	1133.2
15.7	Concealed	1133.2	1148.9
11.3	Sandstone, fine-grained, brownish-gray, medium-bedded, cross-bedded, common black specks	1148.9	1160.2
5.9	Sandstone, same as above but highly micaceous and carbonaceous in places	1160.2	1166.1
6.5	Sandstone, same as above but not highly micaceous or carbonaceous, very thin-bedded in places, common limonite specks in upper 1-foot	1166.1	1172.6
12.4	Sandstone, fine- to medium-grained, brownish-gray and gray, flaggy, thin-bedded	1172.6	1185
2.7	Sandstone, fine-grained, brownish-gray, medium-massive-bedded, cross-bedded, common black specks; elevation of base of section about 815 feet	1185	1187.7

MEASURED SECTIONS

MILL RUN SECTION

Base of section begins at topographic nose at junction of Mill Run and Sinnemahoning Creek and southwest of Mill Run, East Keating Township, Clinton County, Pennsylvania.

Keating 7½ minute quadrangle:

.85 mile north of Latitude 41° 17′ 30″
.45 mile east of Longitude 78° 00′

Measured by A. I. Ingham and J. R. Ebright

THICKNESS FEET	DESCRIPTION OF STRATA	CUMULATIVE THICKNESS IN FEET	
	MISSISSIPPIAN SYSTEM		
	Pocono group, 615.2 feet.		
212.4	Concealed. Several slope changes in this interval suggest lithologic changes: the base of a very steep slope with common coarse-grained sandstone boulders was observed at 103.4 feet from top of section; steepening of slope upwards was also observed at 124.6 and 170 feet from top of section. Typical Pocono-type float found at 199.3 feet from top of section	0	212.4
1.5	Sandstone, medium-grained, grayish-brown, medium-bedded, cross-bedded	212.4	213.9
96.3	Concealed. A sharp increase in slope upwards was observed at 47 feet below top of section	213.9	310.2
2.8	Concealed with red shale float and red soil; distinct flattening of slope upwards begins at base of this interval—*Patton shale?*	310.2	313
40	Sandstone, fine- to medium-grained, brownish-gray and grayish-brown, thin- to medium-bedded; flaggy, thinner-bedded and shaly near top; beginning at 2 feet from base is 5 feet of sandstone with rounded or conchoidal-like fractures	313	353
1	Siltstone, olive-drab, thinly laminated, somewhat cross-bedded	353	354
47.8	Concealed	354	401.8
51.5	Sandstone, fine- to medium-grained, brownish-gray, thin- to medium-bedded, slightly cross-bedded	401.8	453.3
2	Sandstone, fine-grained, shaly, brownish-gray, very thinly laminated, cross-bedded	453.3	455.3
2.8	Sandstone, fine- to medium-grained, brownish-gray, thin-bedded, fairly parallel-bedded	455.3	458.1
1	Sandstone and shale interbedded; sandstone, medium- to coarse-grained, highly carbonaceous, a few small quartz pebbles; shale, olive-drab	458.1	459.1
12.9	Sandstone, medium-grained, brownisb-gray, medium- to massive-bedded, cross-bedded	459.1	472
36.8	Concealed	472	508.8
0.5	Shale, dark-red, silty in part	508.8	509.3
2.8	Concealed	509.3	512.1
14.7	Sandstone, fine- to medium-grained, brownish-gray and grayish-brown, thin- to medium-bedded, cross-bedded	512.1	526.8
1.5	Sandstone, fine- to medium-grained, highly calcareous, fractured, rough weathered surface; this unit is lenticular	526.8	528.3
8.2	Sandstone, fine- to medium-grained, brownish-gray, thin- to medium-bedded, cross-bedded	528.3	536.5
19.3	Concealed	536.5	555.8
1	Sandstone, fine-grained, greenish-gray, thin- to medium-bedded	555.8	556.8
24.8	Concealed with dark red, pitted, limonitic sandstone in upper few feet	556.8	581.6
2	Sandstone, fine- to medium-grained, brownish-gray, thin-bedded	581.6	583.6
15.6	Concealed	583.6	599.2
16	Sandstone, fine- to medium-grained, brownish-gray, thin- to medium-bedded, somewhat cross-bedded	599.2	615.2

MILL RUN SECTION (continued)

THICKNESS FEET	DESCRIPTION OF STRATA	CUMULATIVE THICKNESS IN FEET	
	UPPER DEVONIAN SERIES		
	Oswayo formation, 286.2+ feet.		
55.7	Concealed with red shale float and red soil	615.2	670.9
1	Siltstone, red	670.9	671.9
22.1	Sandstone, fine- to medium-grained, brownish-gray, medium- to massive-bedded, thinner-bedded near top, cross-bedded	671.9	694
5.5	Shale, dark-red in lower and olive-drab in upper part, sandy; at top of section contains a highly calcareous layer with shale pebbles	694	699.5
3.6	Sandstone, very fine-grained, almost shaly, brownish-gray, thin-bedded	699.5	703.1
3.6	Sandstone, siltstone, shale, interbedded; sandstone, very fine-grained, greenish-gray, thin-bedded; siltstone, greenish-gray; shale, olive-drab	703.1	706.7
25.3	Sandstone, fine-grained, brownish-gray and grayish-brown, cross-bedded in part; in places shows reddish-orange weathering	706.7	732
3.6	Sandstone and shale interbedded; sandstone, fine-grained, brownish-gray, thin- to medium-bedded; shale, olive-drab, in part silty	732	735.6
6.5	Sandstone, fine- to medium-grained, grayish-brown and brownish-gray, thin- to medium-bedded, cross-bedded	735.6	742.1
8.2	Sandstone, same as immediately above but bedding planes are rounded, conchoidal-like	742.1	750.3
7.3	Concealed	750.3	757.6
15.6	Sandstone, fine- to medium-grained, greenish-gray and grayish-brown, thin- to medium-bedded, cross-bedded	757.6	773.2
2	Mudstone, highly calcareous, locally almost a limestone, buff vari-colored, badly fractured and has a rough, weathered surface; lenticular	773.2	775.2
2.3	Sandstone, fine- to medium-grained, brownish-gray and greenish-gray, thin-bedded, cross-bedded	775.2	777.5
1.5	Sandstone, highly calcareous, and impure sandy limestone with 3" bed of olive-drab shale in middle of section; brown vari-colored, contains flat clay pebbles and limonite nodules; weathers rough, pitted-like	777.5	779
9.2	Sandstone, fine- to medium-grained, brownish-gray and greenish-gray, thin-bedded, fairly parallel-bedded	779	788.2
4.1	Siltstone, sandstone, and shale interbedded; siltstone. greenish-gray, badly fractured; sandstone, fine-grained, greenish-gray; shale, greenish-gray, hackly and blocky, badly fractured	788.2	792.3
1	Sandstone, fine- to medium-grained, brownish-gray, locally white and "ashy-like," shaly, friable, thin-bedded, common carbonaceous plant remains	792.3	793.3
6.5	Sandstone, fine- to medium-grained, greenish-gray and brownish-gray, thin- to medium-bedded	793.3	799.8
1.5	Sandstone, and impure sandy limestone, interbedded; sandstone is fine- to medium-grained, grayish-brown, thin- to medium-bedded, highly calcareous; sandy limestone is dark-brown	799.8	801.3
7.8	Sandstone, fine- to medium-grained, grayish-brown and brownish-gray, thin- to medium-bedded	801.3	809.1
3.5	Sandstone and impure sandy limestone, interbedded; sandstone, fine- to medium-grained, grayish-brown; sandy limestone, grayish-brown; both sandstone and limestone contain limonite nodules and shale fragments; unit has a pitted, rough weathered surface caused by weathering of limonite nodules	809.1	812.6
6	Sandstone, fine- to medium-grained, grayish-brown and brownish-gray, medium- to massive-bedded, cross-bedded	812.6	818.6
21.2	Sandstone, brownish-gray and greenish-gray, thin- to medium-bedded, cross-bedded	818.6	839.8
61.6	Concealed	839.8	901.4

Measured Sections

OXBOW BEND SECTION

Base of section begins at water level on west side of Kettle Creek, Oxbow Bend, between east slope of a topographic feature known as "The Bunk" and the Creek, and 1000 feet northwest of the mouth of Hevner Run and proceeding up topographic nose between Trout Run and Page Run, Leidy Township, Clinton County, Pennsylvania.

Hammersley Fork 7½ minute quadrangle:

0.55 mile north of Latitude 41° 25′
1.79 miles west of Longitude 77° 52′ 30″
Measured by A. I. Ingham and J. R. Ebright

THICKNESS FEET	DESCRIPTION OF STRATA	CUMULATIVE THICKNESS IN FEET	
	MISSISSIPPIAN SYSTEM		
	Pocono group, 318.5+ feet.		
88	Concealed; at 53 feet from bottom of section the slope steepens upwards and brown and white coarse-grained sandstone float with hematitic bands was observed	0	88
56.3	Sandstone and shale; shale at 10.4 to 23.1 feet above base with standstone above and below; shale, silty, olive-drab; sandstone, fine-grained, brownish-gray, cross-bedded, becoming finer grained and shaly near top; red soil *(Patton shale?)* found immediately above this unit and at base of 88 foot concealed section	88	144.3
86.7	Concealed; abrupt steepening of slope upwards at 49.6 feet from base	144.3	231
10.7	Sandstone, fine-grained, grayish-brown, thin- to medium-bedded	231	241.7
12.4	Concealed; at 1.7 feet from base of this unit slope steepens abruptly upwards	241.7	254.1
14.8	Sandstone, fine-grained, grayish-brown, thin- to medium-bedded	254.1	268.9
49.6	Concealed; base of section is the base of a gentle slope upwards and correlates by interval with the Pocono-Oswayo contact in nearby areas	268.9	318.5
	UPPER DEVONIAN SERIES		
	Oswayo formation, 306.3 feet.		
306.3	Concealed; base of section (Oswayo-Catskill contact) is placed at highest red shale float in the Upper Devonian series; top of section (Pocono-Oswayo contact) is picked as explained above; an abrupt steepening of slope was found between 27.2 feet and 155.9 feet from base	318.5	624.8
	Catskill red beds, 839.4 feet.		
333.1	Concealed; top of Catskill is placed at top of highest red shale float in the Upper Devonian series; red and brownish-red sandstone float was found at 25.7 feet and 112.5 feet from base and red siltstone float at 192 feet from base. Steepening of slope upwards was found at 42.6 feet, 138.4 feet, 216.3 feet, and 274.7 feet from base	624.8	957.9
7.9	Sandstone, fine- to medium-grained, thin-bedded; slope becomes very flat at top of this sandstone. Elevation at top of sandstone is 1290 feet (altimeter)	957.9	965.8
52.1	Concealed; brownish-red siltstone float was found at 37.1 feet above base	965.8	1017.9
55.3	Sandstone, fine- to medium-grained, very thin- to thin-bedded, shaly in part, cross-bedded; at 24 feet from base is 3 feet of coarse calcareous sandstone having blocky weathering	1017.9	1073.2
20.9	Concealed	1073.2	1094.1
3.3	Sandstone, fine- to medium-grained, grayish-brown, thin-bedded, cross-bedded	1094.1	1097.4
46	Concealed	1097.4	1143.4
12.8	Sandstone, fine-grained, brownish-gray and grayish-brown (almost a red), thin- to medium-bedded; some reddish-brown sandstone float	1143.4	1156.2
172.1	Concealed; red siltstone-sandstone float was found from bottom to 74.2 feet above base of section	1156.2	1328.3
18	Siltstone, sandstone, and shale; siltstone, brick-red, sandy, medium- to massive-bedded; sandstone, very fine-grained, brick-red, medium- to massive-bedded; sbale, brick-red, silty, blocky	1328.3	1346.3

OXBOW BEND SECTION (continued)

THICKNESS FEET	DESCRIPTION OF STRATA	CUMULATIVE THICKNESS IN FEET	
72.8	Concealed, mainly red soil	1346.3	1419.1
17.9	Shale and sandstone; shale, brick-red and light-green, with increasing amounts very fine-grained dark-brown and greenish-gray sandstone near top; shale fragments were found in sandstone in places	1419.1	1437
27.2	Siltstone and sandstone, interbedded; siltstone, brownish-red, thin- to medium-bedded, highly micaceous; sandstone, fine-grained, greenish-gray and brick-red, medium- to massive-bedded; a few fossil fragments near top—Ostracoderm plates (fish plates)	1437	1464.2
	Chemung (?) facies, 22+ feet.		
17.5	Concealed; top of Chemung is placed at base of lowest red	1464.2	1481.7
4.5	Sandstone, very fine to fine-grained, greenish-gray, thin-bedded, flaggy, ripple marks, slightly calcareous in places, shale fragments near base. Elevation at base of section 916 feet (altimeter)	1481.7	1486.2

SUMMERSON RUN SECTION

Base of section starts on east bank of Kettle Creek at U. S. G. S. Bench mark 810 feet where Summerson Run crosses Kettle Creek road and proceeds up topographic nose between Summerson Run and Kettle Creek, Leidy Township, Clinton County, Pennsylvania.

Keating 7½ minute quadrangle:

0.57 mile north of Latitude 41° 20′

1.82 miles west of Longitude 77° 52′ 30″

Measured by A. I. Ingham and J. R. Ebright

THICKNESS FEET	DESCRIPTION OF STRATA	CUMULATIVE THICKNESS IN FEET	
	MISSISSIPPIAN SYSTEM		
	Pocono group, 425.3+ feet		
79.1	Sandstone, medium- to coarse-grained, occasionally fine-grained, conglomeratic at base with pebbles of milky quartz up to ½″ in diameter, angular to sub-rounded, irregularly shaped, not flat; color of section is yellowish- and reddish-brown, white near top, hematitic streaks near base; medium- to massive-bedded, rarely thin-bedded. Base of the conglomerate is the contour horizon of the accompanying structural map. Elevation at top of this section is 1537 feet (altimeter)	0	79.1
74.7	Concealed; an abrupt steepening of slope upwards and red silty shale *(Patton shale?)* float was found at 8.8 feet from base	79.1	153.8
38.7	Sandstone, fine- to medium- and occasionally coarse-grained, grayish-brown, thin-bedded, flaggy in places; strata near base are rounded, spheroidal-like	153.8	192.5
70.3	Concealed	192.5	262.8
2	Sandstone, medium-grained, brownish-gray and grayish-brown, thin-bedded	262.8	264.8
7.4	Concealed	264.8	272.2
44.3	Sandstone, fine- to medium-grained, grayish-brown and greenish-gray, thin-bedded, cross-bedded, locally calcareous; there are a few thin concealed intervals in this section	272.2	316.5
108.8	Concealed with abrupt steepening of slope upwards at 9.8 feet from base	316.5	425.3
	UPPER DEVONIAN SERIES		
	Oswayo formation, 168.1+ feet		
9.7	Concealed with red silty shale float	425.3	435
2.2	Sandstone, very fine to fine-grained, grayish-brown, thin-bedded	435	437.2
32.3	Concealed; red soil was observed from base up to 4.8 feet above base	437.2	469.5
16.3	Sandstone, very fine to fine-grained, very thin to thin-bedded, thin brownish-red layers near top	469.5	485.8
107.6	Concealed; elevation at base of section about 810 feet (from U. S. G. S. temporary bench mark)	485.8	593.4

MEASURED SECTIONS

HYNER VIEW SECTION

Lower end of section begins near northeast end of Susquehanna River bridge crossing, approximately 0.7 mile southeast of Hyner, on north side of Route 120, and just west of Huff Run. Section proceeds upward on topographic nose to intersection with a hairpin turn on Hyner View Road and continues upward on road to a point approximately 0.1 mile northeast of temporary bench mark 1949, Glen Union quadrangle. Entire section is in Chapman Township, Clinton County. The new Hyner View Road was opened in 1949 and is not shown on the U. S. G. S. topographic maps.

Renovo East and Glen Union 7½ minute quadrangles:

.43 mile south of Latitude 41° 20′
.45 mile west of Longitude 77° 37′ 30″

Measured by A. I. Ingham and J. R. Ebright

THICKNESS FEET	DESCRIPTION OF STRATA	CUMULATIVE THICKNESS IN FEET	
	MISSISSIPPIAN SYSTEM		
	Pocono group, 511.6+ feet		
90+	Sandstone and conglomerate, much of the upper part of the interval being occupied by abundant boulder float; the section is predominantly white with some yellow and red and ranges from coarse-grained sandstone to a conglomerate with rounded and angular irregularly shaped to ovoid quartz pebbles and cobbles up to ¾ inch in diameter; the conglomerate is restricted to the lower 20± feet of the section and appears to correlate with a prominent Pocono conglomerate of Leidy Township, Clinton County, contour horizon of the accompanying structural map (pl. 1)	0	90
141.1	Concealed with common streaks of red, whitish, and yellowish soil; yellowish soil confined to upper 30′±; there is an abrupt increase in slope upwards at the top of this unit (base of the conglomerate described above)	90	231.1
2	Shale, red and green, silty with 2 inch white clay bed; common carbonaceous plant material	231.1	233.1
5	Concealed, red shale float	233.1	238.1
12.3	Sandstone and shale; sandstone is fine-grained, greenish-gray, thin-bedded, highly micaceous and common carbonaceous plant remains in places; shale, less common than the sandstone, is silty, olive-drab	238.1	250.4
33.4	Sandstone, fine-grained, brownish-gray, medium- to massive-bedded, cross-bedded with 2 feet silty, grayish-green shale 3 feet from base; at 15 feet from base sandstone shows spheroidal bedding pattern	250.4	283.8
24.6	Siltstone and shale, predominantly siltstone, greenish-gray and olive-drab; at 4.4 feet from base is 1 foot of mottled brownish-red and light-green shale; upper part of the section shows spheroidal bedding pattern similar to unit above	283.8	308.4
28.5	Shale, dark-gray, and some olive-drab near top; some thin brownish-gray, fine- to medium-grained sandstone beds up to 3 inches thick throughout section, and a 3 foot brownish-gray fine- to medium-grained sandstone lens near top	308.4	336.9
3	Conglomerate and sandstone, predominantly sandstone; section consists of medium- to coarse-grained grayish-brown sandstone with rounded and sub-angular quartz pebbles; rare thinly laminated shale beds	336.9	339.9
35.8	Sandstone, fine- to medium-grained, brownish-gray and greenish-gray, flaggy and medium- to massive-bedded; at 13.3 feet from base are 2± feet of impure sandy limestone, transecting the bedding of the sandstone, containing limy or sideritic rounded concretions to ¾ inch in diameter; this limestone where weathered is pitted and becomes a blackish-brown sandy mass; at 19.6 feet above base is 2± feet sandy shale and shaly sandstone, highly limonitic with thin coal seams; a few pyrite concretions to 3 inches in diameter were found near top of the section	339.9	375.7
12.3	Shale, olive-drab and brownish-gray, becoming silty near top	375.7	388
4	Shale, brownish-gray, with 1 inch bed white clay 1 foot from base and some brownish-red shale in upper 1½ feet	388	392
11.8	Sandstone, fine- to medium-grained, brownish-gray; some beds show spheroidal bedding pattern	392	403.8

HYNER VIEW SECTION (continued)

THICKNESS FEET	DESCRIPTION OF STRATA	CUMULATIVE THICKNESS IN FEET	
21.6	Shale, olive-green and yellowish-brown, in part silty, becoming very sandy near top with some fine-grained brown sandstone beds	403.8	425.4
23.6	Sandstone, fine- to medium-grained, gray and brownish-gray, medium- to massive-bedded with spheroidal bedding pattern near base; two 3 foot impure sandy limestone beds weathering to dark blackish-brown at 11.2 feet and 19.2 feet from base; at 15.2 feet from base is a 1 foot lenticular "conglomerate" consisting of rounded brownish-gray shale fragments up to 3 inches in diameter in a light-gray sandstone matrix	425.4	449
1.5	Shale, olive-drab, rare plant fossils	449	450.5
2	Limestone, very impure, sandy, containing limestone or sideritic concretions up to 3 inches in diameter which when broken open frequently contain calcite crystals	450.5	452.5
8±	Shale, brick-red, some light-green; this is a very lenticular unit of variable thickness	452.5	460.5
51.1	Sandstone, brownish-gray and light-gray, fine- to medium- and rarely coarse-grained, massive; two thin impure sandy limestone beds weathering to a dark blackish-brown mass at 25.5 and 30.5 feet above base; large concretionary sandstone masses within a few feet of top	460.5	511.6

UPPER DEVONIAN SERIES

Oswayo formation, 324.9 feet

THICKNESS FEET	DESCRIPTION OF STRATA	CUMULATIVE THICKNESS IN FEET	
8.9	Shale, brownish-red and light-green, very thin-bedded, easily weathered	511.6	520.5
23.1	Sandstone and shale interbedded; sandstone, fine-grained, brownish-gray and brick-red; shale, brick-red; in upper part both sandstone and shale are brick-red	520.5	543.6
6.5	Sandstone, fine- to medium-grained, brownish-gray, massive with some brownish-gray and greenish-gray siltstone beds near top	543.6	550.1
24	Shale, predominantly brick-red, some pale-green, becoming sandy, silty and more green toward top; limonite seams in upper part; lower part of section more thin-bedded than upper. The contact between this unit and the one below is very sharp	550.1	574.1
6	Sandstone, very fine to fine-grained, mottled dark-brown and grayish-green, massive	574.1	580.1
24.2	Sandstone, fine- to medium-grained, light-gray and greenish-gray; exterior stained brick-red perhaps caused by red units above; common rounded fractures; at 12.2 feet above base is 6 inch olive-drab shale bed	580.1	604.3
3	Calcareous breccia consisting of an impure limestone matrix, varicolored bluish-gray, olive-drab and grayish-brown, with common rounded shale fragments, irregularly limonitic, rare calcite crystals, weathers pitted	604.3	607.3
6	Sandstone, medium- to coarse-grained, light-gray, massively-bedded	607.3	613.3
3.6	Shale, medium-gray to brownish-gray, very lenticular	613.3	616.9
8.4	Sandstone, fine- to medium-grained, brownish-gray and greenish-gray, massive-bedded, somewhat cross-bedded	616.9	625.3
2	Calcareous breccia; this is the same as the 3 foot breccia unit four units above; the shale fragments are similar to the shale immediately below	625.3	627.3
28	Sandstone and shale in thick interbeds; sandstone, fine-grained, greenish-gray, thin- to medium-bedded, cross-bedded; shale, brownish-gray and olive-drab; carbonaceous plant remains in places	627.3	655.3
30.9	Sandstone, fine- to medium-grained, grayish-green, flaggy; a 2-foot, and two thin impure sandy limestone beds are found at 10.8, 18.6, and 23 feet from base respectively; these limy units weather to a dark blackish-brown sandy mass, having a more or less rounded weathered face	655.3	686.2
2	Shale, olive, somewhat silty in places, upper part of which appears to be a reworked shale in a sandy matrix; occasional carbonaceous material	686.2	688.2
33.4	Sandstone, fine- to medium-grained, occasional coarse grains, greenish-gray and brownish-gray, thin- to medium-bedded near base becoming medium- to massively bedded above, cross-bedded, common muscovite, occasional carbonaceous plant and shale fragments, common dark-brown limonite specks; at 17.7 feet from base is a 2" layer of grayish-green sandy shale and sandy shale with shale fragments and common manganese oxide(?) stains; at 22.1 feet from base is 2 feet of impure sandy limestone which weathers to a dark blackish-brown sandy mass with a more or less rounded weathered surface	688.2	721.6

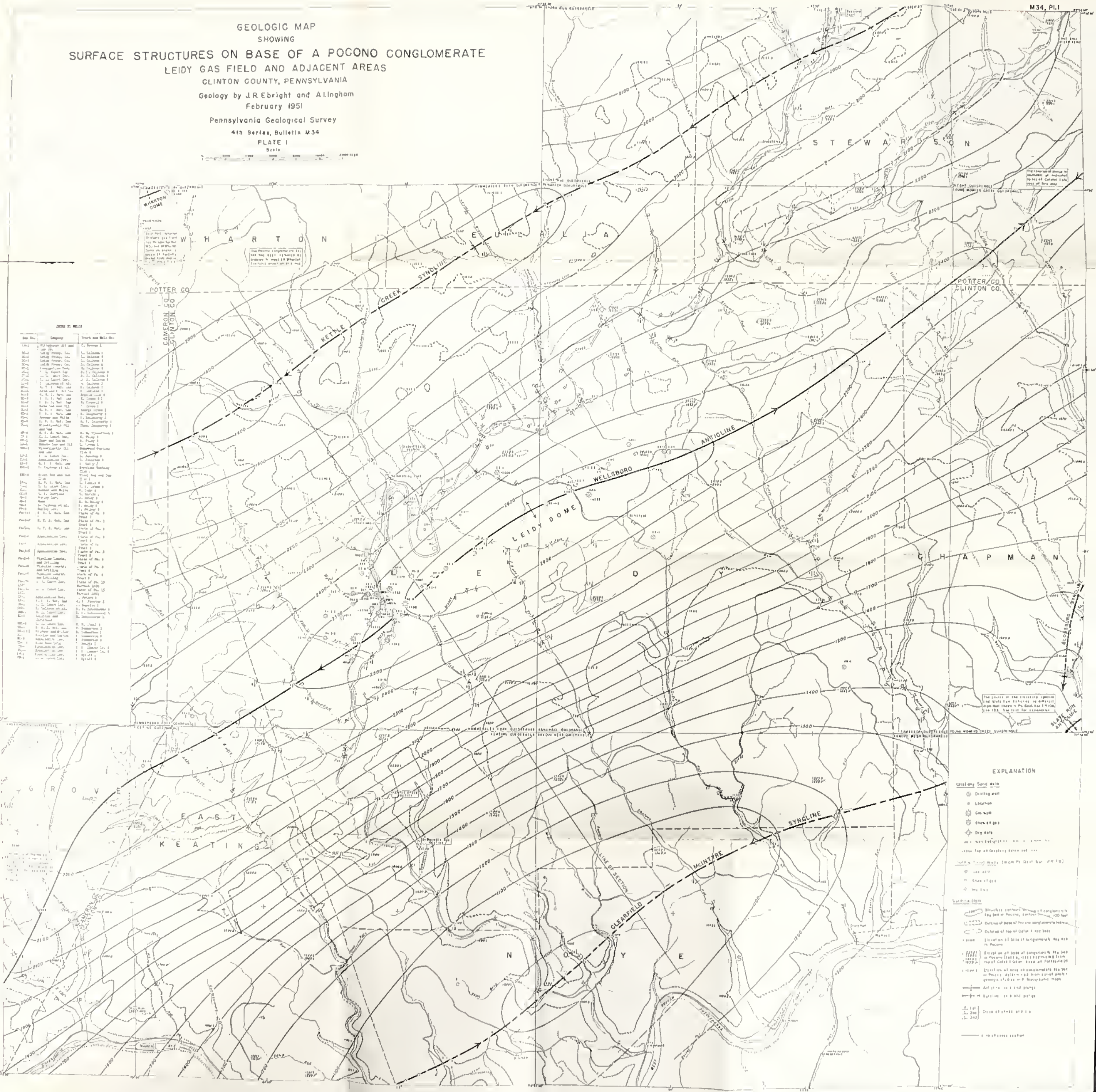
HYNER VIEW SECTION (continued)

THICKNESS FEET	DESCRIPTION OF STRATA	CUMULATIVE THICKNESS IN FEET	
114.9	Concealed, with rare red sandy shale float and rare red soil from base to 92.1 feet above base	721.6	836.5
	Catskill red beds, 596.2+ feet		
209	Concealed with continuous red shale float and red soil	836.5	1045.5
110.2	Sandstone, fine- to medium-grained, greenish-gray and brownish-gray with abundant olive-drab shale fragments to 1¼" in diameter at base; thin- to medium-bedded, rather rounded weathering, friable and highly micaceous in part, medium- to locally thin-bedded, common dark-brown limonite(?) specks; at 28.1 feet above base is a 6 inch lens of calcareous breccia like 2 foot and 3 foot calcareous breccia units described above; at 69.9 feet above base is a 6 inch lens of highly calcareous sandstone, yellowish-white, weathering white	1045.5	1155.7
54	Concealed with red silty shale float and red soil; at 21.6 feet above base is a slight steepening of slope upwards	1155.7	1209.7
4.3	Sandstone, fine- to medium-grained, brownish-red, thin-bedded; slight flattening of slope upwards at top of this unit	1209.7	1214
35.6	Sandstone, fine- to medium-grained, greenish-gray and brownish-gray, thin-bedded	1214	1249.6
5.4	Limestone and interbedded calcareous breccia; limestone is impure, sandy, bluish-gray on fresh fracture, weathering to a medium-brown or brownish-gray sandstone; calcareous breccia is like calcareous breccia beds described above containing shale fragments to ¾ inch in diameter and small limestone concretions	1249.6	1255
17.9	Sandstone, fine- to medium-grained, brownish-red, thin-bedded, cross-bedded	1255	1272.9
10.6	Concealed with brownish-red sandstone float	1272.9	1283.5
11.6	Sandstone, fine-grained, brownish-red, thin-bedded, cross-bedded, irregularly shaly	1283.5	1295.1
28.5	Sandstone, medium- to coarse-grained, light-gray and brownish-red, thin-bedded and cross-bedded	1295.1	1323.6
42	Sandstone, fine-grained, brownish-red, thin-bedded, locally paper thin, cross-bedded, dark-brown limonitic specks	1323.6	1365.6
67.1	Concealed	1365.6	1432.7

GEOLOGIC MAP
SHOWING
SURFACE STRUCTURES ON BASE OF A POCONO CONGLOMERATE
LEIDY GAS FIELD AND ADJACENT AREAS
CLINTON COUNTY, PENNSYLVANIA

Geology by J. R. Ebright and A. Ingham
February 1951

Pennsylvania Geological Survey
4th Series, Bulletin M34
PLATE I
Scale



GEOLOGIC MAP
SHOWING
SUBSURFACE STRUCTURE CONTOURS ON TOP OF ORISKANY SANDSTONE
LEIDY GAS FIELD AND ADJACENT AREAS
CLINTON COUNTY, PENNSYLVANIA

Geology by J. R. Ebright and A. Lingham
February 1951

Pennsylvania Geological Survey
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PLATE 2